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STOPPING WATER POLLUTION AT ITS SOURCE

MISA

Municipal/Industrial Strategy for Abatement

The Draft Development Document

for the

Effluent Limits Regulation

for the

MISA Metal Casting Sector

Ontario

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DRAFT DEVELOPMENT DOCUMENT FOR THE EFFLUENT LIMITS REGULATION MISA METAL CASTING SECTOR

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DRAFT DEVELOPMENT DOCUMENT FOR THE

EFFLUENT LIMITS REGULATION

MISA METAL CASTING SECTOR

Report prepared by:

Water Resources Branch
Ministry of Environment and Energy

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INTRODUCTION

The Municipal/Industrial Strategy for Abatement (MISA) program is a Ministry of the Environment and Energy (MOEE) program to reduce the discharge of toxic contaminants to Ontario's waterways. Under the first phase of MISA, dischargers were required to monitor and report on the contaminants present in their effluent. This information has subsequently been used to set legal discharge limits requiring reductions in toxic discharges to the levels attainable with the best available technology. The ultimate goal of the MISA program is the virtual elimination of persistent toxic contaminants from all discharges into Ontario's waterways.

This document is comprised of seven chapters. The first chapter of this document is introductory and presents the background to MISA and the main features of the program. A brief description of the effluent limits regulation development process for the Metal Casting Sector is given.

Chapter two presents information about the Sector and the production processes used in the Sector. The Sector consists of eight direct discharge metal casting plants. Information about each plant is given, including its location, production capacity, processes used and the type and treatment of plant effluents.

Chapter three contains information about the effluent monitoring data used in the development of the effluent limits. The chapter includes a summary of the data collected under the voluntary pre-regulation effluent monitoring program and under the one year regulated MISA effluent monitoring period. The complete MISA effluent monitoring database is presented in the Twelve Month Monitoring Data Report. Data validation, candidate parameter selection and QA/QC data assessment are briefly described in this chapter.

Chapter four describes the assessment of available technologies for the control of plant effluent discharges and the identification of those technologies considered to be the "best available". This chapter also examines the financial impact of each of the "best available" technology options on each plant in the Sector.

Chapter five describes the economic assessment process. Cost effectiveness of BAT options is calculated, ability of the Ontario metal casting plants to increase prices is reviewed and the competitiveness and the impact of BAT option costs on metal casting plants are evaluated.

Chapter six describes the effluent limits development process. It outlines the results of the selection of candidate parameters for limits, the development of plant-specific parameter lists and plant-specific effluent loading limits. Contaminant loading reductions and the effluent limits in other jurisdictions are discussed briefly.

The seventh chapter presents a summary of the key components of the effluent limits regulation for the Sector. Compliance requirements and monitoring frequencies are defined, as are other regulation requirements such as toxicity testing criteria and flow measurement accuracy.

EXECUTIVE SUMMARY

This document describes the steps involved in the development of effluent limits for the Metal Casting Sector.

Under the Effluent Monitoring Regulation for the Metal Casting Sector, ten direct-discharging plants were required to conduct one year of comprehensive effluent monitoring starting on May 1, 1990. A total of 161 conventional and priority pollutants were monitored on a daily, thrice weekly, weekly, monthly, quarterly and semi-annual basis.

Sixty three parameters were selected as candidate parameters for effluent limits setting for the ten[a] direct-discharging plants comprising the Ontario Metal Casting Sector.

Parameters were removed from further consideration for effluent limit setting if the QA/QC data assessment showed that their presence in the effluent was highly suspect, or if the effluent monitoring data were of limited quality or unreliable quality. Twenty eight parameters were identified as having reliable data for use in the development of effluent limits.

The Ministry hired a consultant to develop an inventory of available pollution control treatment technologies for the Metal Casting Sector.

The consultant was asked to identify:

- The best available technology train in Ontario (BAT #1)
- The best available technology train in the U.S. (BAT#2)
- The best available technology train at selected world locations (BAT#3)
- The best available technology train that produces a non-lethal effluent (BAT#4)
- The best available technology train that advances the goal of the virtual elimination of persistent toxic substances (BAT#5).

[a] Ten plants carried out the MISA effluent monitoring, however, when the monitoring was finished one plant became a zero discharger (Canada Pipe, Hamilton) and the other one closed its operation in Ontario (Franklin Electric, Strathroy). Consequently, only eight plants have been considered for effluent limits setting.

The consultant divided the Ontario metal casting plants into three categories: Wet Processes, Haley Industries and Dry Processes.

The plants in the Wet Processes Category consist of foundries that use large volumes of water for dust collection, furnace exhaust scrubbing and slag quenching.

Haley Industries is a casting plant with extensive metal finishing (mechanical and chemical) operations. Since Haley Industries is a unique operation not comparable to any of the other metal casting plants, it is in a category by itself.

The plants in the Dry Processes Category are either small foundries or die casting plants and their water use is for cooling purposes. Since the plants in the Dry Processes Category discharge only non-contact cooling water, they will not be limited.

The two BAT options identified for the Wet Processes Category are BAT #1 (the best in Ontario) and BAT #2-5 (a plant that is found in the U.S. which is also the best in the world and satisfies the non-lethality requirements and advances the goal of the virtual elimination of persistent toxic contaminants).

The main treatment technology associated with BAT#1 (General Motors, St. Catharines) consists of flocculation/ coagulation, clarification, partial biological treatment and oil removal/skimming. The BAT#2-5 treatment technology train includes clarification, cooling and recycle of all process effluents; collection, evaporation cooling and recycle of most non-contact cooling waters; collection and recycle of storm water run-off; biological (extended aeration) treatment; filtration of clarified effluent and ion exchange.

The consultant identified the existing technology train with in-plant process optimization at Haley Industries as the best available technology train (BAT#1) for the Haley Industries Category. The technology train consists of metals removal (chemically assisted flocculation/coagulation), silver recovery, biological (extended aeration) and activated carbon adsorption treatment technologies.

The consultant identified two BAT options for the Dry Processes Category. The BAT#1 option consists of oil/water separation and sand and/or carbon filtration. The BAT#2-5 option focuses on total recycle of the cooling water discharges.

In order to develop effluent limits based on the BAT options, the Ministry conducted an economic assessment of the costs of imposing the identified BAT options on the Metal Casting Sector. Since the five plants included in the Dry Processes Category will not be limited (non-contact cooling water plants), cost estimation was not carried out.

Implementation of the BAT#1 train on the remaining two categories (Wet Processes and Haley Industries) could cost the Metal Casting Sector as much as $920,000 in capital costs and $70,000 per year in operating costs. Over a ten year period these costs could represent an annualized after-tax expenditure of $140,000 per year.

Implementation of the BAT#2-5 train on the remaining two categories (Wet Processes and Haley Industries) could cost the Metal Casting Sector as much as $11.8 millions in capital costs and $240,000 per year in operating costs. Over a ten year period these costs could represent an annualized after-tax expenditure of $1.4 millions per year.

Based on a review of the technical information and on the results of the economic assessment, the Ministry concluded that the most cost-effective control options consisted of:

- Monitoring for assessment for the Dry Processes Category
- BAT#1 option for the Wet Processes Category
- BAT#1 option for the Haley Industries Category

The five plants in the Dry Processes Category will be required to monitor pH, dissolved organic carbon and total suspended solids, for assessment in order to ensure that their effluent remains contaminant free. In addition, Western Foundry and Kubota Metal Corporation will be required to monitor phenolics, and Chrysler and Western Foundry will be required to monitor fluoride.

For the Wet Processes and Haley Industries Categories, following the identification of the preferred BAT option, the 28 candidate parameters selected for effluent limit setting were further evaluated in order to determine those parameters for which technically defendable effluent limits could be developed. Four parameters were removed from further consideration because they were characteristic of Canada Pipe's discharges only. Eleven parameters were removed because there were no demonstrated performance data available

in the metal casting industry to show that they could be controlled with the identified best available treatment trains. For the remaining thirteen parameters, daily maximum and monthly average production-based loading limits were developed based on BAT plant performance data.

General Motors has announced the closure of its foundry in St. Catharines by the fall of 1994. Therefore, this plant is not considered for effluent limit setting. However, its performance data, as a BAT plant, has been used to set the effluent limits for the Ford Motor plant.

Between the two remaining plants (Ford Motors and Haley Industries), production-based loading limits were developed for the following parameters:

- total cyanide
- ammonia plus ammonium
- nitrate plus nitrite
- dissolved organic carbon
- total phosphorus
- total suspended solids
- aluminum
- chromium
- copper
- silver
- zinc
- phenolics (4AAP)
- biochemical oxygen demand

Plant specific loading limits were then calculated for each plant by multiplying the daily and monthly average production-based loading limits by the reference production rate for the plant. The reference production rate for each plant reflects the production rate corresponding to the design capacity of the plant.

The following regulation requirements apply to all plants in the Metal Casting Sector:

- plants must not discharge effluent acutely lethal to rainbow trout and Daphnia magna (water fleas)

- plants must conduct chronic toxicity testing following twelve consecutive months of non-lethal acute lethality test results,

In addition, plants in the Wet Processes and Haley Industries Categories must discharge effluent within the pH range of 6.0 to 9.5.

Metal casting plants will have up to three years to comply with these requirements which will allow the plants sufficient time to implement the necessary pollution prevention and control strategies and install the necessary capital equipment.

The proposed effluent limits for the Metal Casting Sector represent a significant step forward in the overall protection of human health and aquatic life in Ontario. They are a major step forward towards the Ministry's goal of the virtual elimination of persistent toxic substances.

THE MISA INITIATIVE

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1.1 THE MISA PROGRAM

The MISA program was officially announced by the Ontario Ministry of the Environment in the White Paper of June 1986[1]. MISA is a regulatory program for reducing water pollution from both industrial and municipal dischargers. Initially, technology-based effluent limits will be imposed on each discharger as a minimum pollution control requirement. In addition, more stringent effluent limits may be imposed on dischargers on a site-specific basis to protect local sensitive receiving water bodies. The ultimate goal of MISA is the virtual elimination of persistent toxic contaminants from all discharges into Ontario's waterways.

The process to develop technology-based effluent limits for industrial direct discharges involved two phases. In the first phase, an effluent monitoring regulation required direct dischargers to monitor their point source effluents at regular intervals according to specific sampling, analytical, flow measurement and quality assurance and quality control protocols and procedures. The Effluent Monitoring Regulation for the Metal Casting Sector was designed to provide an accurate report on the discharge of conventional and priority pollutants by the ten[b] direct discharge plants in Ontario. The regulation was developed by the Ministry in consultation with representatives from the Ontario Metal Casting Industry, MISA Advisory Committee and Environment Canada through the MISA Metal Casting Sector Joint Technical Committee (JTC).

The specific requirements of the Effluent Monitoring Regulation for the Metal Casting Sector are presented in Ontario Regulation 648/89 as amended to Ontario Regulations 232/90 and 419/90[2]. A detailed explanation of the rationale behind the specific requirements in the effluent monitoring regulation is presented in the Development Document for the Effluent Monitoring Regulation for the Metal Casting Sector[3].

The second phase of the development of technology-based effluent limits involved the development and implementation of the effluent limits regulation for the Sector, using the data collected under the monitoring regulation.

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[b] Ten plants carried out the MISA effluent monitoring, however, when the monitoring was finished one plant became a zero discharger (Canada Pipe, Hamilton) and the other one closed its operation in Ontario (Franklin Electric, Strathroy). Consequently, only eight plants have been considered for effluent limits setting.

1.2 THE EFFLUENT LIMITS REGULATION DEVELOPMENT PROCESS

The effluent limits regulation for the Metal Casting Sector will regulate the eight direct discharge metal casting plants in Ontario.

The process which was followed in developing the effluent limits regulation for the Metal Casting Sector was initially outlined in the MISA White Paper[1]. Each step is briefly described below:

Step 1: Effluent Monitoring

Under the Effluent Monitoring Regulation, direct dischargers were required to monitor for a comprehensive list of parameters. Up to 161 parameters were monitored on a daily, thrice weekly, weekly, monthly, quarterly and semi-annual basis in process effluent, cooling water effluent, storm water effluent and emergency overflow effluent.

Step 2: Candidate Parameter Selection

Statistical tests were applied to the effluent monitoring data to determine candidate parameters for effluent limits setting. Parameters were considered as candidates for effluent limits setting if the effluent monitoring data showed, at a 95% confidence level, that 10% or more of the data for that parameter and for that effluent were at concentrations greater than or equal to the parameter's Regulation Method Detection Limit.

Step 3: QA/QC Data Assessment

Quality assurance/quality control (QA/QC) data were evaluated in order to determine the reliability of the effluent monitoring data for use in the effluent limits setting process. Data which were considered unreliable were eliminated from further consideration in the effluent limits setting process.

Step 4: BAT Identification

Best available technologies (BAT) were identified and BAT options, representing different levels of pollution control and abatement, were determined. The BAT options were reviewed in order to identify the parameters that would be treated if the options were installed at Ontario plants.

Step 5: Economic Assessment

Information about estimated pollutant removal efficiencies and the costs of the various BAT options was used to derive abatement cost functions which indicate the relationship between increasingly stringent levels of control and the cost of achieving them. The financial and economic consequences of implementing the various levels of control to the Metal Casting Sector in Ontario were also estimated. The information on the identified BAT options and the financial impacts of each option on the Sector were used to determine the preferred BAT option.

Step 6: Effluent Limits Setting

Production-based effluent loading limits were developed based on the performance of the preferred BAT option using the procedures outlined in the Issue Resolution Committee Reports on Monitoring Data Analysis and Limits Setting[4].

1.3 REFERENCES

1. Ontario Ministry of the Environment (1986). Municipal-Industrial Strategy for Abatement (MISA). A Policy and Program Statement of the Government of Ontario on Controlling Municipal and Industrial Discharges into Surface Waters."The White Paper". Toronto, Ontario.

2. Government of Ontario (1989). Ontario Regulation 648/89 as amended to Ontario Regulation 232/90 and 419/90 under the Environmental Protection Act -- Effluent Monitoring - Metal Casting Sector.

3. Ontario Ministry of the Environment (1989). The Development Document for the Effluent Monitoring Regulation for the Metal Casting Sector. Toronto, Ontario. ISBN:0-7729-6293-6

4. Ontario Ministry of the Environment (1990). MISA Issue Resolution Committee Reports. Toronto, Ontario.

THE INDUSTRIAL SECTOR

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2.1 INDUSTRY PROFILE

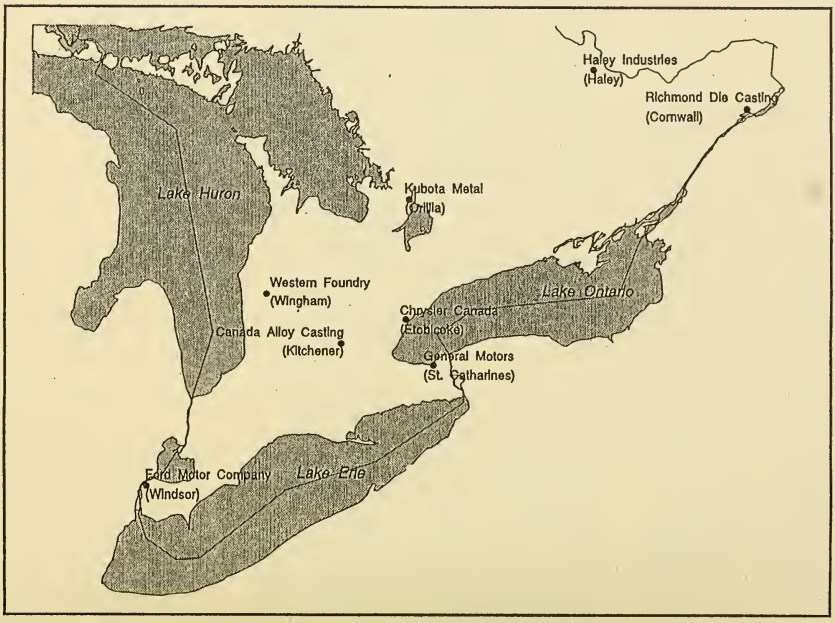
Ontario metal casting industry employs about 10,000 people. This represents about two thirds of total employment in the Canadian metal casting industry[1], 0.2% of the total Ontario workforce and about 1.0% of manufacturing employment.

The Metal Casting Sector manufactures a variety of products which can be divided between ferrous and non-ferrous goods. In the ferrous category, these products are made from steel, malleable iron, ductile (nodular) iron and gray iron. In the non-ferrous category, products are made from aluminum, copper, magnesium, zinc and their associated alloys.

Castings vary widely in size, alloy composition, complexity of shape and tolerance. The range of products manufactured by the Ontario Metal Casting Sector varies from small electric components weighing a few grams to large industrial machine parts weighing several tonnes. There are at least 30 different product market segments for metal casting. Some of the more notable products include automotive engine and transmission parts, industrial machinery and equipment, construction materials, railway parts, agricultural equipment, aerospace components, electrical parts and tools.

There are eight metal casting plants located in the Province of Ontario that discharge effluent directly to surface watercourses. Figure 2.1 identifies the names and the locations of the eight plants of the Metal Casting Sector. Table 2.1 lists the plants, the approximate number of employees at each plant during MISA monitoring, the daily production, the raw materials used and the major parts produced.

Figure 2.1 Location of Direct Discharge Metal Casting Plants In Ontario



Economic Overview

From the economical point of view, growth rates of shipments of both castings and durable goods seem to indicate that metal casting shipments have not kept up with durable goods shipments. Even during the boom of the mid and late 1980's, the industry did not experience growth similar to its end products. This may suggest that the metal casting industry is in decline.

Possible reasons for the decline of the metal casting industry in North America include the following:

- Increase use of substitute materials such as plastics, ceramics and powdered metals.
- Manufacturers move to smaller and lighter end products, therefore reducing the total volume of their end products.
- New and improved technologies for producing metal parts.
- Demise of traditional industries such as shipbuilding and railway stock rolling.
- Increase in manufactured imports into Canadian economy.

A more detailed industry profile, from the economic point of view, can be found in Appendix A.

2.2 PRODUCTION PROCESSES

Every metal casting operation consists of several basic processes. Metal must be heated to a molten state, introduced into a mold, removed from the mold and finished into a final product. The product flow of a typical metal casting operation is shown in Figure 2.2.

For the sake of simplicity, only the main metal casting processes used in Ontario are discussed below.

Melting Process

Many melting techniques are applied in Ontario using various types of furnaces: cupola furnaces, electric arc furnaces, induction furnaces, reverberatory furnaces and crucible furnaces. The type of furnace depends on the metal charged and the desired end product.

Table 2.1
The MISA Metal Casting Sector
Final Products and Employment (1990)

COMPANY	NUMBER OF EMPLOYEES	PRODUCT (t/d)	METAL (RAW MATERIALS)	MAJOR PRODUCTS
FOUNDRIES				
Canada Alloy Casting Ltd., Kitchener	110	57	stainless steel	industrial equipment castings
Ford Motor Company of Canada Limited, Windsor Casting Plant; Windsor	1000	650	nodular iron gray iron	automotive parts
General Motors of Canada Ltd., St. Catharines	4650	1510	nodular iron gray iron	automotive parts
Haley Industries Ltd., Haley	413	2.7	aluminum magnesium	aerospace industry castings
Kubota Metal Corporation, Fahramet Division, Orillia	240	28	stainless steel	industrial equipment parts
Western Foundry Company Limited, Wingham	300	269	nodular iron	automotive parts
DIE CASTERS				
Chrysler Canada Ltd., Etobicoke	450	68	aluminum	automotive parts
Meridian Richmond Die Casting , Cornwall	125	11	aluminum	automotive parts

In all types of metal casting plants raw materials are assembled and stored in separate material bins. From these bins, a "furnace charge" is prepared using various amounts of the desired materials. The furnace charge is heated in a melting furnace until molten.

There is usually a system for cleaning the melting furnace off-gases which may be either dry (baghouses or electrostatic precipitators) or wet (scrubbers). In ferrous foundries slag may be removed intermittently from the melting furnace and is usually water quenched for granulation to facilitate disposal.

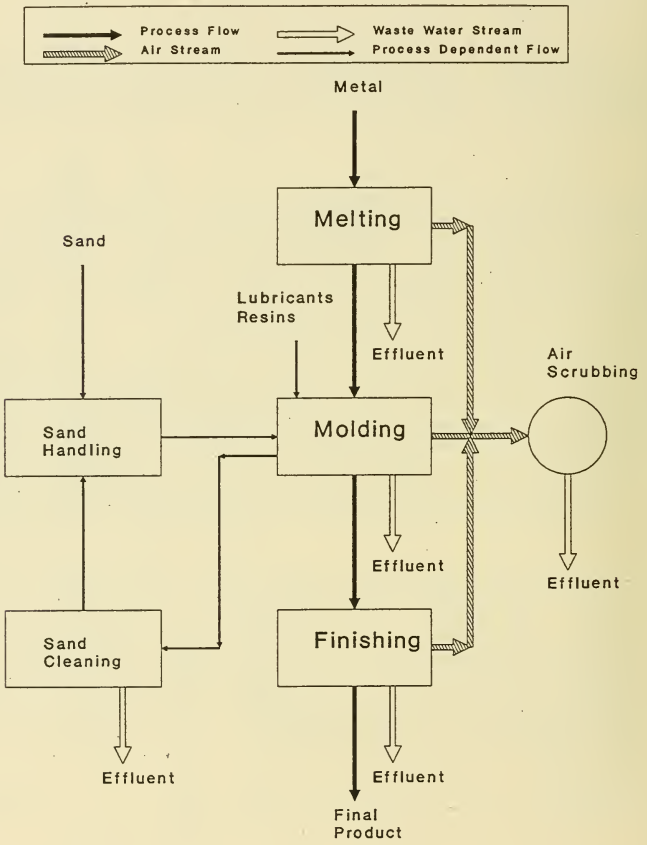
Metal Molding Process

In general, molding techniques can be divided into permanent and non-permanent processes. Permanent processes are those in which the mold is not destroyed in the casting process and include centrifugal casting, die casting, ceramic mold casting, permanent mold casting and direct chill casting. Non-permanent techniques are those in which the mold is destroyed during the casting process and include sand casting, investment casting and full mold casting.

In the permanent molding process, the mold is made of metal and can be used many times. In die casting operations, for example, the mold cavity is formed in metallic die blocks which are locked together to make a complete cavity. The cast object is removed from the die casting machine after cooling sufficiently to retain its shape. The casting is either further cooled in a water bath or is allowed to air cool on a cooling table. Die casting operations are mostly automated and can produce large amounts of precise castings in a very short time.

The non-permanent molding process begins by forming a pattern (usually of wood) of the approximate final shape of the product. The pattern is usually made in two pieces, although patterns may consist of three or more pieces. Each part of the pattern is used to form a cavity in a moist sand media that forms part of the mold. The two parts of the mold are then matched together to form the complete mold cavity, which is then ready to receive molten metal. An entrance hole provides the proper path for the introduction of molten metal into the mold cavity.

Figure 2.2
Typical Metal Casting Processes



Molten metal is "tapped" from the furnace into a ladle. The ladle and mold are moved to a pouring area and the molten metal is poured into the mold. The mold is then moved to a cooling area where the molten metal solidifies into the shape of the pattern. When sufficiently cooled, the sand is removed by a process known as "shake out". By violent shaking, the sand surrounding the metal is loosened, falls away and is returned to the sand storage area for reclamation or disposal.

Metal Finishing Process

The cast metal object called a casting, can be further processed by grinding to remove excess metal. Grinding can be conducted with or without an auxiliary wet or dry air cleaning system. Castings are cleaned by various methods that complete the removal of the sand and other impurities from the cast surfaces. These cleaning operations may include washing with water or may be conducted by physical abrasion such as shot blasting or sand blasting. Dust generated by shot blasting and sand blasting can be collected in wet air pollution control devices (duct collection scrubbers).

Depending on the metallurgical properties desired, some castings may undergo a heat treatment or annealing step that ends with a water quench. Surface treatment operations such as acid cleaning or chrome coating are often employed. Dye penetrants are often used for quality control to identify structural flaws in the casting product.

2.3 OVERVIEW OF AVAILABLE TECHNOLOGIES

General information about the technologies used by the Metal Casting Sector is presented in the following section. Detailed overview of available technologies is given in the Best Available Technology for Effluent Treatment in the Metal Casting Sector report[2].

Table 2.2 lists the metal casting plants in Ontario and their present effluent treatment systems.

Chemically Assisted Clarification

Chemically assisted clarification is normally used as an initial treatment step for removing metals, suspended solids and oil and grease. It involves hydroxide precipitation (coagulation/flocculation using alum or ferric chloride) with or without polymer addition, followed by sedimentation in a mechanical clarifier or settling basin.

Table 2.2
Plants and their Present Effluent Treatment Systems

Plant	Treatment Type
Canada Alloy Casting	Sand Filtration
Chrysler Canada	Oil Separation
Ford Motor Company of Canada	Coagulation/Flocculation; Oil Separation
General Motors of Canada	Coagulation/Flocculation; RBC
Haley Industries	Coagulation/Flocculation; Extended Aeration; Chemical Reduction; Silver Recovery; Activated Carbon Adsorption
Kubota Metal Corporation, Fahramet Division	Carbon Filtration; Settling Pond
Meridian Richmond Die Casting	Oil Separation
Western Foundry Company	-

Calcium triple super phosphate (TSP) is another chemical which is used at several foundries in the U.S.for the purpose of chemically assisted clarification. TSP is added to the process wastewaters from dust collectors and scrubbers to help immobilize heavy metals in the settled sludges. This allows many foundries to pass toxicity tests and permits a reclassification of the resulting sludge from hazardous to non-hazardous. A secondary effect of TSP addition is to control hardness and alkalinity build-up in recycle loops. The phosphorus added with TSP dosing must be removed from solution during the treatment of the blowdown.

Chemical Oxidation/Reduction

Several chemical oxidation and reduction processes are used in the Metal Casting Sector to treat contaminants. The most common chemicals used are:

- Potassium Permanganate: Oxidation of phenolics (4AAP) and cyanide;
- Chlorine Dioxide: Oxidation of cyanide;
- Hydrogen Peroxide: Oxidation of nitrite to nitrate; ferrous ion to ferric ion; cyanide
- Sodium Metabisulphite: Reduction of hexavalent chromium to trivalent chromium; and
- Ferrous Ion: Reduction of hexavalent chromium to trivalent chromium.

Carbon Adsorption

Activated carbon, either granular or powdered, is used at a number of metal casting plants, to remove dissolved organic compounds from the wastewater.

Biological Treatment

Extended aeration and rotating biological contactors (RBC's) are two of the biological processes used for treating dust collector/scrubber blowdowns containing phenolics and other compounds that contribute to high Biochemical Oxygen Demand (BOD).

Aerated or facultative stabilization basins are also suitable for BOD removal, if designed properly and if the winter operating temperatures are kept sufficiently high.

Suspended Solids Polishing

Sand filters, dual media filters and pressure filters are used in the casting industry to reduce suspended solids concentrations. These unit operations are generally employed after primary clarification or following the secondary clarifier in a biological treatment process.

Ion Exchange

Silver Recovery

Ion exchange is used to recover silver at metal casting plants which use x-rays for quality control purposes. The silver is recovered from spent fixer solutions and rinse waters using an electrolytic recovery process.

Copper, Lead and Zinc Removal

Ion exchange is also used to remove copper, lead and zinc. Zinc is often the metal of primary concern and zinc removal is usually over 90 percent using a single stage ion exchange system. The selectivity that some resins show for heavy metals, and particularly bivalent metals, while leaving calcium and magnesium unaffected is the unique feature which has allowed ion exchange to be technically and economically feasible at metal casting plants.

Oil Separation

Oil separation is achieved by emulsion breaking using chemical and/or thermal methods. Both methods are highly reliable and they can be either batch or continuous processes.

2.4 INDUSTRY CATEGORIES

Due to the variety of manufacturing processes, raw materials used and the various water uses, the Metal Casting Sector was divided into three categories. These categories include:

1. The Dry Processes Category - Includes five plants with non-contact cooling water effluent.

2. The Wet Processes Category - Includes two foundries with process effluent.

3. The Haley Industries Category - Includes one plant (casting and finishing) with process effluent.

The plants in each category, the types of casting processes and furnaces used, and the destination of their discharge are listed in Table 2.3 .

Table 2.3
Industry Categories

Category	Plant Name	Casting Process	Furnaces	Discharge
Dry Processes	Canada Alloy Casting Ltd., Kitchener	Silica sand Air set	Induction	Lake Erie via Grand River
	Chrysler Canada Ltd., Etobicoke	Die casting Permanent mold	Reverberatory	Lake Ontario
	Kubota Metal Corporation, Fahramet Division, Orillia	Shell sand Green sand Cold set Centrifugal	Electric arc Induction	Lake Simcoe
	Meridian Richmond Die Casting, Cornwall	Die Casting	Reverberatory	St. Lawrence River via Fraser Creek
	Western Foundry Company Limited., Wingham	Green sand Cold box	Induction	Maitland River
Wet Processes	Ford Motor Company of Canada, Windsor Casting Plant, Windsor	Green sand Heat set Cold set	Cupola Induction	Detroit River
	General Motors of Canada Ltd., St. Catharines	Green sand Heat set Cold set Shell sand	Cupola Induction	Welland Canal
Haley Industries	Haley Industries Ltd., Haley	Silica sand Heat set Cold set	Crucible Induction	Ottawa River via McLaren's Creek

Dry Processes Category

The five plants in the Dry Processes Category which discharge non-contact cooling water are briefly described below in terms of plant size, products manufactured, number of employees, wastewaters generated and effluent treatment systems in place.

Canada Alloy Casting Ltd. (Kitchener)

The plant produces carbon and stainless steel castings for a variety of industries, including pulp and paper, hydro electric, nuclear and military. In 1990, the plant had 110 employees and produced 57 tonnes of molten metal per day.

The production process is essentially a dry operation with negligible process water requirements. There are no wet dust collectors or furnace exhaust scrubbers. The plant uses city water for sanitary purposes and for cooling air compressors and furnaces. The water from the sanitary facilities together with the casting quench water is discharged into the sanitary sewers. The water from the air compressors, furnaces, and filter backwash is discharged into Lake Erie via the nearby creek and Grand River.

Water treatment at this plant consists of an automatic pressure filter (sand filtration) which is used to remove suspended solids from recycled cooling water.

Rejected castings and waste sands containing fines, resins and catalyst from the shakeout area are stored outside.

The 1990 MISA Effluent Monitoring results indicate an average estimated flowrate of 187 m^3/day. The toxicity test results indicate that the effluent was not acutely lethal to rainbow trout in 3 of the 3 samples, and to Daphnia magna in 2 of the 3 samples that were collected.

Chrysler Canada Ltd. (Etobicoke)

The plant produces automotive parts such as pistons, master brake cylinders and various engine and transmission system components. In 1990, the plant had 450 employees and produced 68 tonnes of aluminum castings per day.

The plant uses city water for sanitary purposes and for cooling water and process water. Cooling water is used to

cool furnace door frames, hydraulic oil heat exchangers, dies, molds, air compressors and the associated after-coolers used in the compressed air system, and to quench-cool master brake castings. Water temperature is controlled using a cooling tower, or by direct city water addition. Cooling water discharges to the storm sewer which flows into Lake Ontario via a nearby creek.

The local municipal sewage treatment plant receives process waste water from an oil separator, overflow from an impregnation rinse process, blowdown from any or all of three steam boilers, air compressor cooling water and blowdown from the cooling system which cools molds and master brake cylinder castings.

The cooling water from the plant does not receive any treatment. The effluents from the die cast sumps and the blowdown from the permanent mold cooling loop, however, are pumped through an oil/water separator to remove die lubricants and other immiscible organic chemicals.

There is a die cast trim and finishing operation within the plant. Some castings from the die cast area are made water tight by an impregnation step using a sodium silicate solution. Pistons and master brake cylinders are heat treated.

The 1990 MISA Effluent Monitoring results indicate an average effluent flowrate of 1,484 m^3/day. For this plant, the toxicity test results were inconclusive due to analytical problems with the contract laboratory.

Kubota Metal Corporation, Fahramet Division (Orillia)

The plant produces stainless steel and steel alloy castings for pipes and miscellaneous industrial equipment, mainly for the petrochemical sector. In 1990, the plant had 240 employees and produced 28 tonnes of steel castings per day.

Kubota uses very little water for process applications. City water is used for cooling furnaces and compressors. Water from the cooling loops, together with storm water runoff, flows to the cooling pond, where a portion is recycled back to the plant and the rest is discharged to Lake Simcoe via a nearby storm ditch. A small amount of water is evaporated in the quenching operation, in the sand cooler and on the cooling pond surface.

Sanitary effluent and dye penetrant rinses are discharged to the local municipal sewage treatment plant.

There is no specific effluent treatment process at Kubota besides the natural settling or biodegradation that may occur in the cooling pond.

A variety of finishing and quality assurance operations such as shot blast and dye penetrant applications are employed within the plant. All dust collection is by dry methods (i.e. baghouses). The plant has heat treatment facilities, a quenching operation and a sand reclamation system.

The 1990 MISA Effluent Monitoring results indicate an average effluent flowrate of 360 m^3/day. The toxicity test results indicate that the effluent was non-acutely lethal to rainbow trout and Daphnia magna in the 5 samples that were collected.

Meridian Richmond Die Casting (Cornwall)

The plant produces custom aluminum castings largely for the automotive industry. In 1990 the plant had 125 employees and produced 11 tonnes/day of aluminum castings.

Richmond Die Casting receives its water directly from the St. Lawrence River. There is no water recirculation or reuse at the plant. Untreated and unfiltered water is used in the process for non-contact cooling, as well as for sanitary purposes. A small amount of the intake water is filtered and disinfected for drinking purposes.

Sanitary effluent is treated by going through a tile bed located on the company's property. Non-contact cooling water is discharged into Fraser Creek which flows directly into the St. Lawrence River (down stream from the intake point).

In addition to the tile bed treatment of sanitary effluent, the other type of water treatment carried out at Richmond Die Casting is the oil separation from the cutting fluids which are used during the machining process. The plant employs several wet grinding/finishing operations and the fluids used are recirculated.

The 1990 MISA effluent monitoring results indicate an average effluent flowrate of 1,984 m^3/day. The toxicity test results show that the effluent was not acutely lethal to rainbow trout and to Daphnia magna in the 3 samples that were collected.

Western Foundry Company Limited (Wingham)

The plant produces exhaust manifolds for the automotive industry. In 1990, the plant had 300 employees and produced 269 tonnes/day of castings.

The Western Foundry plant uses town water for cooling air compressors and furnace heat exchangers, process water and for sanitary purposes. Cooling water and storm water flow into the Maitland River via two discharge streams.

The cooling and storm water discharges receive no specific treatment. An in-plant de-ionization process creates spent regenerants which are discharged together with the effluent from SO_2 scrubbers to the sanitary sewers.

The 1990 MISA effluent monitoring results indicate that the total effluent flowrate of the two discharge streams was 1,290 m^3/day. The 1990 MISA toxicity test results indicate that the effluent was non-acutely lethal to rainbow trout and to Daphnia magna in the 5 samples that were collected.

Wet Processes Category

The two plants in the Wet Processes Category which discharge process effluent are briefly described below in terms of plant size, products produced, number of employees, wastewaters generated and effluent treatment systems in place.

Ford Motor Company of Canada Limited, Windsor Casting Plant, (Windsor)

The plant produces nodular and gray iron automotive parts including crankshafts, engine blocks and other components for engine assembly plants. In 1990, the plant had 1,000 employees and produced 650 tonnes of castings per day.

Water is pumped directly from the Detroit River for cooling water and process water use. Process water from the engine and casting plants is sent to two treatment facilities. Engine plant discharges are sent to an oily waste treatment plant and casting plant discharges are sent to a clarification plant.

The oily waste treatment plant is designed to treat batches of coolant solutions containing concentrated emulsified oil and oily wastewater from industrial water overflows. Each batch is treated with sulphuric acid, calcium chloride and sodium hydroxide to separate the wastewater into oil and water. The water from these tanks is discharged into the sewer. The concentrated oil is removed from the plant site by a licensed oil reclamation company.

The Casting Plant process wastewater comes from the slagging operation of two cupolas and a number of dust collectors. It is treated with alum and polymer prior to entering two clarifiers. Solids from the clarifiers are pumped into one of two adjacent settling lagoons. The treated water flows over a weir trough system and discharges into a combined sewer.

Non-contact cooling water, storm water, and treated process water discharge to the combined sewer. The water is fed by gravity to two screw pumps which lift the water to the polishing lagoon. This polishing lagoon provides settling capacity for suspended solids and enables the operators to contain, clean up and divert any oil that may by-pass the system (e.g. yard run-off).

The 1990 MISA Effluent Monitoring results indicate an average effluent flowrate of 73,590 m^3/day. The toxicity test results show that the effluent was acutely lethal to rainbow trout in 6 of the 13 samples and to Daphnia magna in 8 of the 13 samples that were collected.

General Motors of Canada Ltd. (St. Catharines)

The plant consists of the foundry and engine plant. The foundry produces gray and nodular iron automotive castings. The engine plant machines and assembles V6 and V8 engines. A small aluminum die casting operation is located in the engine plant. In 1990 the plant had 4,650 employees and the foundry produced 1,510 tonnes/day of castings.

The majority of water is gravity-fed via a pipe line from the Welland Canal. The remainder of the water is supplied via a city water main. Water is used for non-contact cooling and process requirements.

Process water is used for wet dust collectors, cupola furnace exhaust wet cap and venturi scrubbers, and cupola slag quenching. Non-contact cooling water is used to cool cupola shells, induction furnaces, holding furnaces and air

compressors. Cooling water for the induction melting furnace is on a closed loop system with heat dissipation via a cooling tower.

A small process stream from one of the wet scrubbers is collected separately and treated biologically for phenol removal in a Rotating Biological Contactor (RBC) before it merges with the rest of the process effluent.

All process water is treated at the suspended solids treatment plant consisting of coagulation/flocculation and sedimentation in two parallel clarifiers. Effluent from the plant flows to a polishing pond which discharges into a ditch. The process flow measurement and sampling point is located at the discharge from the polishing pond. Non-contact cooling water, storm water and effluent from an on-site sanitary plant intercepts the ditch downstream of the polishing pond. The combined effluent enters a final lagoon for further polishing prior to being discharged to the Welland Canal. The combined flow measurement and sampling point is located at the discharge from the final lagoon.

The 1990 MISA effluent monitoring results indicate an average effluent flowrate of 135,627 m^3/day. The toxicity test results indicate that the combined effluent was acutely lethal to rainbow trout in 11 of the 13 samples and to Daphnia magna in 6 of the 13 samples that were collected.

Haley Industries Category

Haley Industries differs from the other plants in the Metal Casting Sector by having casting and metal finishing processes. It is briefly described below in terms of plant size, number of employees, products produced, wastewaters generated and effluent treatment systems in place.

Haley Industries Ltd. (Haley)

The plant produces magnesium and aluminum castings for the aerospace industry. In 1990 the plant had 413 employees and made 2.7 tonnes/day of castings.

Intake water is drawn from nearby Pumphouse Lake. The water is used for sanitary purposes and for process, cooling and finishing operations. Wastewater discharges flow into the Ottawa River via McLaren's Creek.

Process wastewater discharges include discharges from the wastewater treatment plant (WWTP), sewage treatment plant (STP) and wet dust collectors. The WWTP consists of a number of batch treatment processes treating wastewater from the SO_2 mold curing process, acid etch process, and chromate pickling process.

The effluent from the SO_2 mold curing process consists of sulphur dioxide and sodium sulphate/sulphite dissolved in a sodium hydroxide solution. The mixture is allowed to settle and the supernatant is pumped through a carbon filter before being discharged.

The effluent from the acid dip tanks and dragout tanks, in the acid etch process, are neutralized with calcium hydroxide and allowed to settle. The supernatant is then discharged.

Wastewater overflow from the acid etch process and chromate pickling process are neutralized (pH = 7) using sodium hydroxide and are stored in the WWTP prior to discharge.

Dragout water from the chromate pickling process is treated with sulphuric acid and sodium metabisulphite to convert hexavalent chromium to trivalent chromium. Calcium hydroxide is then added to neutralize the effluent and precipitate the contaminants. The supernatant is then discharged.

Spent fixer from two X-Ray processors is treated using silver recovery units and then combined with the wastewater overflow from the acid etch and chromate pickling processes. This waste stream is then combined with the streams being discharged from the WWTP.

The Sewage Treatment Plant consists of a biological (extended aeration) process. It receives domestic wastewaters, water from laboratory sinks, and effluent from the Fluorescent Penetrant Inspection (FPI) process. The FPI effluent is passed through activated carbon filters, to remove oil and fluorescent dye, before being discharged to the STP.

The metal finishing operations include shot blasting, grinding and heat treatment. Dust is created in the wheelabrator shot blast machines, sanding and grinding booths and the Rotary Multiple Hanging blast machine. Wet scrubbers are used to treat the dust and the resulting wastewater is discharged into the process wastewater stream.

Storm water collected from plant roof areas, car parks and yard areas is discharged to McLaren's Creek separately from process wastewater.

The 1990 MISA effluent monitoring data results indicate an average effluent flowrate of 128 m^3/day for process water and 107 m^3/day for storm water. The toxicity test results indicate that the effluent was acutely lethal to rainbow trout in 11 of the 13 samples and to Daphnia magna in 6 of the 13 samples that were collected.

2.5 REFERENCES

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2. Beak Engineering Limited (1992). Best Available Technology for Effluent Treatment in the Metal Casting Sector. Toronto, Ontario. ISBN 0-778-0564-2

THE EFFLUENT MONITORING DATABASE

CHAPTER 3

OF THE

DEVELOPMENT DOCUMENT

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3.1 EFFLUENT MONITORING

Pre-Regulation Effluent Monitoring

In 1987, the Ontario Metal Casting Industry conducted a comprehensive study on the composition of metal casting plant effluents being discharged directly to Ontario surface waters[1]. The study, conducted under the auspices of the Metal Casting Environmental Committee, was designed to generate data for the development of the Effluent Monitoring Regulation for the Metal Casting Sector.

The results of the pre-regulation effluent monitoring study are documented in the report entitled "Results of MISA Pre-Regulation Monitoring-Metal Casting Sector"[1] and in the Development Document for the Effluent Monitoring Regulation for the Metal Casting Sector[2].

The list of parameters to be monitored during the MISA Effluent Monitoring Regulation was developed based on the parameters identified during this pre-regulation effluent monitoring. The complete list of parameters is presented in Appendix B.

MISA Effluent Monitoring

The effluent monitoring data for the Metal Casting Sector were collected under Ontario Regulation 648/89 as amended to O. Reg. 232/90 and O. Reg.419/90. The ten direct discharge* plants in Ontario were required to monitor their effluent for one year period starting on May 1, 1990. Up to 161 parameters were monitored on a daily, thrice weekly, weekly, monthly, quarterly and semi-annual basis.

The Development Document for the Effluent Monitoring Regulation for the Metal Casting Sector[2] outlines the rationale that was used in the development of the Effluent Monitoring Regulation.

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* At the end of the monitoring period, Canada Pipe became a zero discharger and Franklin Electric closed down. Consequently, only eight direct discharge plants were considered for effluent limits setting.

Effluent Monitoring Data

The MISA effluent monitoring data are presented in the Twelve Month Monitoring Report for the Metal Casting Sector[3]. The twelve months of effluent monitoring generated 53,750 data points, including 15,701 quality assurance/quality control data points. Table 3.1 lists the quantity of data points for each plant.

Table 3.1
Quantity of Effluent Monitoring Data

Company Name and Location	Effluent Monitoring	QA/QC	Total
Canada Alloy Casting Ltd., Kitchener	268	0	268
Canada Pipe Company Ltd., Hamilton	1622	457	2,079
Chrysler Canada Ltd., Etobicoke	277	174	451
Ford Motor Company of Canada, Windsor Casting Plant, Windsor	13138	4794	17932
Franklin Electric of Canada, Strathroy	993	641	1634
General Motors of Canada, St. Catharines	11229	4862	16091
Kubota Metal Corporation, Fahramet Division, Orillia	999	304	1303
Haley Industries, Haley	8727	4469	13196
Meridian Richmond Die Casting, Cornwall	261	0	261
Western Foundry Co. Ltd., Wingham	535	0	535
Sector Total	38049	15701	53750

Note:Data reflects finalized Ministry database as of December, 1992

3.2 DATA VALIDATION

In order to confirm the integrity of the information contained in the effluent monitoring database, it was necessary to conduct a rigorous data validation exercise. Data validation involved the following:

Units Verification

The data were analyzed to ensure that the correct units were reported for each parameter for the entire monitoring period. Where the use of incorrect units was identified, direct dischargers were required to resubmit the data with the correct units. The use of data with incorrect units could produce a large error in the calculation of parameter loadings.

Multiple Record Identification

The data were analyzed to determine whether two or more records existed for the same parameter, for the same control point and for the same day. When multiple records were identified, the incorrect records were removed from the database. The presence of incorrect records could adversely affect the calculation of parameter loadings.

Sample Type Code Verification

Sample type codes were reviewed in order to ensure that the appropriate sampling procedures were used to collect samples for the analysis of halogenated and non-halogenated volatiles. The proper method of sampling for the analysis of parameters in these analytical test groups is the collection of a three grab composite sample.

Remark Code Verification

Remark code usage was checked to ensure that the data were correctly identified and labelled. Dischargers were required to resubmit effluent monitoring data that were labelled incorrectly. Table 3.2 lists the remark code definitions for the remark codes used during the effluent monitoring period for the Metal Casting Sector.

Table 3.2
Remark Codes

Remark Code	Description
<	Actual amount less than reported
<DL	Reported value = MDL :measured amount MDL (non-zero)
<T	A measurable trace amount: interpret with caution
<W	No measurable response (zero): reported value
?	Late data: data not yet available
A	Approximate value
AIS	Approximate value: insufficient sample
AR	Attached report
I	Interference suspected
IB	Interference: background
N/A or !	No data will be reported
OLD	Old: sample exceeds maximum storage time
SD	Sample duplicates differ in appearance
SIP	Sample improperly preserved
UCR	Data unreliable: could not confirm by reanalysis
UQC	Data unreliable: possible lab QC problem(s)
!IN	No data: insufficient volume due to inspection
!NM	No effluent: no sample available
<SQ	Less than based on semi-quantitative method
P60	PCB resembled AROCLAR 1260
SFA	Sample filtered, filtrate analyzed
SQT	Result based on semi-quantitative method
UIN	Unreliable: indeterminate interference
!RO	See attached report, no numerical data
!TC	Total ratio Cr:Pb < 1.0 ppm

Effluent monitoring data reported with no remark code, or those that were reported with the remark codes "<", "<DL", "<T", "A", and "AR" were accepted as valid data and were used for data analysis and limit setting purposes. Data submitted

with any other remark codes were rejected as questionable and were excluded from the data analyses. The questionable data amounted to less than 1% of the total database.

Effluent monitoring data with the remark codes "<DL", and "<T" were used according to the procedures outlined in the draft Issue Resolution Committee Reports[4] on data analyses. These data were used as reported unless the reported value was less than the Regulation Method Detection Limit (RMDL) divided by 10 in which case the RMDL/10 value was used. Data with remark codes "<", "AR" and "A", or with no remark code were used as reported.

Attached Report Investigation

All of the effluent monitoring data with the attached report, "AR", remark code were investigated during the data validation exercise. No concerns were identified with the data and all were used during subsequent data analysis.

Database Completeness Confirmation

The number of data points for each control point were totalled for each month in order to determine the completeness of the effluent monitoring database. The total point count was monitored throughout the data collection period to ensure that the database was as complete as possible.

Outlier Investigation

Statistical data outliers were identified according to the general procedures outlined in the draft Issues Resolution Committee Reports[4]. Outlier values may result from plant and process upsets, QA/QC problems, sampling errors or unknown causes. They may be non-representative of normal plant operating conditions or may be indicative of other environmental problems requiring investigation. Outlier values were examined to ensure that all data points were correctly reported and that the outlier values were not the result of data entry error. Direct discharges with outlier values due to data entry error were required to resubmit the correct values. Validated MISA effluent monitoring data results were published in the Twelve Month Monitoring Data Report for the Metal Casting Sector[3].

3.3 CANDIDATE PARAMETER SELECTION

Following data collection and validation, the selection criteria identified in the draft Issue Resolution Committee Report on Selection of Parameters for Limits[4] were used to determine candidate parameters for effluent limits setting.

A parameter was considered as candidate for effluent limits setting if the effluent monitoring data showed, at a 95% confidence level, that 10% or more of the data for that parameter and for that effluent, were at concentrations greater than or equal to the parameter's Regulation Method Detection Limit.

A total of 63 parameters were selected as candidate parameters for effluent limit setting. The parameter pH was not included in candidate parameter selection because it will be regulated separately under the effluent limits regulation.

3.4 QA/QC DATA ASSESSMENT

Following candidate parameter selection, quality assurance/ quality control (QA/QC) data were examined in order to determine whether the effluent monitoring data for the parameters selected for effluent limits setting were of reliable quality and were acceptable for use in the development of effluent limits.

In the Metal Casting Sector, the plants that discharge process (Ford, General Motors, Haley Industries) and combined effluents (Canada Pipe) were required to carry out the QA/QC testing and to monitor greater number of parameters on a more frequent basis, than the five plants discharging cooling water (Canada Alloy Casting, Chrysler, Kubota Metal Corporation, Meridian Richmond Die Casting and Western Foundry), since the process and combined effluents have the potential of impacting the environment the most.

The QA/QC data assessment involved the retrieval and screening of the field QA/QC data and corresponding process effluent monitoring data. The data were sorted, summarized and evaluated according to the procedures outlined in the draft Issue Resolution Committee Reports on Quality Assurance and Quality Control[4]. A parameter was removed from further consideration in the effluent limits setting process if the QA/QC data assessment indicated that its presence in plant effluent was highly suspect or if all of the data for the parameter were of limited quality or unreliable quality.

Table 3.3 lists the parameters that were removed from further consideration in the effluent limits setting process because the QA/QC data assessment indicated that their presence in

Table 3.3
Results of QA/QC Data Assessment
Parameters to be Removed from the List

ATG	Parameter
9	Cobalt
9	Berylium
13	Tetra-alkyl lead (Total)
13	Tri-alkyl lead (Total)
16	Chloroform
16	Methylene Chloride
17	Benzene
17	Toluene
17	o-Xylene
19	Benzobutylphthalate
20	4-Nitrophenol
20	Pentachlorophenol
26	Abietic Acid
26	Chlorodehydroabietic Acid
26	Dehydroabietic Acid
26	Isopimaric Acid
26	Levopimaric Acid
26	Neoabietic Acid
26	Oleic Acid
26	Pimaric Acid

plant effluent was highly suspect. Table 3.4 lists the parameters that were removed from further consideration because the effluent monitoring data were of limited or equivocal quality.

Table 3.5 presents the parameters which remained as candidate parameters for effluent limits following the QA/QC data assessment. Four parameters (cadmium, molybdenum, nickel and

Table 3.4
Results of QA/QC Data Assessment
Parameters with Data of Equivocal Quality

ATG	Parameter
8	Volatile Suspended Solids
9	Vanadium
15	Sulphide
16	1,1-Dichloroethane
19	Bis(2-ethylhexyl)phthalate
20	2,4-Dimethylphenol
23	1,2,3-Trichlorobenzene
24	Octachlorodibenzofuran
24	Total H6CDD
24	Total H6CDF
24	Total H7CDD
24	Total H7CDF
24	Total PCDF
24	Total TCDF
27	PCBT

oil & grease) were selected only for Canada Pipe, which became a zero discharge plant shortly after the monitoring was completed. These parameters have, therefore, been removed from further consideration in the effluent limits setting process. Full details of the QA/QC data assessment are presented in the report on the Quality Assurance and Quality Control Data Analyses for the Metal Casting Sector[5].

Table 3.5
Results of QA/QC Data Assessment
Parameters to be Limited

ATG	Parameter
1	Chemical Oxygen Demand
2	Total Cyanide
4a	Ammonia plus Ammonium
4a	Total Kjeldahl Nitrogen
4b	Nitrate plus Nitrite
5a	Dissolved Organic Carbon
5b	Total Organic Carbon
6	Total Phosphorus
8	Total Suspended Solids
9	Aluminum
9	Cadmium *
9	Chromium
9	Copper
9	Lead
9	Molybdenum *
9	Nickel *
9	Silver
9	Zinc
9a	Iron
9a	Magnesium
10	Antimony
10	Arsenic
10	Selenium
12	Mercury
14	Phenolics (4AAP)
24	Octachlorodibenzo-p-dioxin
25	Oil and Grease *
30	Fluoride

* Parameters characteristic only to the effluent of Canada Pipe, which became a zero discharger.

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BEST AVAILABLE TECHNOLOGY

CHAPTER 4

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4.1 BEST AVAILABLE TECHNOLOGY (BAT)

The Ministry commissioned a consultant study in June 1991 to identify Best Available Technology (BAT) for the Metal Casting Sector and to determine the costs of retrofitting Ontario metal casting plants with the identified BAT. The results of the BAT study[1] were subsequently used by the Ministry to conduct an economic assessment of imposing the identified BAT options on the Metal Casting Sector and to identify the preferred options for the Sector.

The BAT Study

The objectives of the BAT study were threefold:

- To assemble design, performance and cost (operating and capital) information on available effluent treatment technologies, in-plant controls and best management practices in Ontario.
- To assemble design, performance and cost (operating and capital) information on best available effluent treatment technologies, in-plant controls and best management practices worldwide.
- To evaluate and recommend at least five BAT options that could be applied to the Metal Casting Sector in Ontario.

The BAT consultant was asked to identify the following BAT options:

BAT#1 A BAT option that utilizes the best technologies currently in use in Ontario metal casting plants.

BAT#2 A BAT option that utilizes the best technologies currently in use in U.S. metal casting plants.

BAT#3 A BAT option that utilizes the best technologies currently in use in metal casting plants in North America, Europe, or Asia.

BAT#4 A BAT option that produces non-lethal effluent.

BAT#5 A BAT option consisting of any technologies or combinations of technologies which advance the plants in the Metal Casting Sector towards the MISA goal of the virtual elimination of persistent toxic chemicals.

Available Technologies

In order to develop the inventory of best available technologies for the pollution control of metal casting plant effluent discharges, the consultant had to first identify all available pollution control technologies used by metal casting plants. The consultant developed an initial list of available technologies based on professional experience, visits to Ontario metal casting plants, reviews of technologies used in other countries, and reviews of all of the relevant scientific literature.

The BAT consultant reviewed available technologies in Canada and the world including the USA, Germany, Japan, Taiwan, China and Korea. Available technologies were evaluated in terms of their ability to reduce pollutants in the effluent from metal casting plants similar to those in Ontario. In evaluating available technologies, the following aspects were considered:

- Changes in production processes
- In-plant control measures
- Effluent treatment technologies
- Best management practices
- Chemical substitution
- Water conservation
- Energy conservation.

The consultant reviewed the list of available technologies and selected those technologies that can be considered demonstrated technologies.

Demonstrated Technologies

A demonstrated technology is a technology for which data are available and can be used to predict, with a reasonable degree of confidence, the reliability of the performance of the technology with respect to contaminant reductions. It should also be possible to successfully retrofit the demonstrated technology into existing facilities.

The consultant used the following criteria to select demonstrated technologies from the list of available technologies:

- The technology is used in the Metal Casting Sector or in a similar industrial sector that produces effluents with similar characteristics
- The technology can be retrofit in at least some or all of the existing facilities
- The technology has been in commercial use for a significant time, generally at least one year
- Design/sizing and costing information for the technology is available or sufficient information is available to develop it,
- Bench or pilot-scale technology can be considered in some cases of specific interest.

Development of Categories Within the Sector

The eight plants in the sector were divided into three separate categories. The following factors were considered in establishing the categories:

- Raw materials
- Industrial processes
- Products manufactured
- Use of process chemicals
- Effluent treatment technology
- Sources of process effluent.

The three separate categories were:

1. The Dry Processes Category - consists of plants that discharge non-contact cooling water. Plants in this category include two aluminum die casters (Chrysler and Richmond Die Casting) and three ferrous based foundries (Canada Alloy Castings, Kubota Metal Corporation and Western Foundry).

2. The Wet Processes Category - consists of foundries that use large volumes of process water for dust collection, furnace exhaust scrubbing and slug

quenching. Plants in this category include General Motors of Canada and the Ford Motor Company of Canada.

3. The Haley Industries Category - consists of the casting and metal finishing plant, Haley Industries. The nature of the process effluent produced at Haley and the type of wastewater treatment processes used by the plant, dictate that Haley Industries should be treated as a separate category.

BAT Selection

The consultant identified BAT options for each plant category. The BAT options represent integrated groups of proven, demonstrated pollution control technologies that can be used to improve effluent quality substantially. The BAT options differ in cost and resulting effluent quality and serve as the basis for identifying the preferred BAT option for the Metal Casting Sector.

The BAT Options

The consultant identified two BAT options for the Dry Processes Category, two BAT options for the Wet Processes Category and one BAT option for the Haley Industries Category. These options are briefly described below. More detailed discussion is presented in the Report on Best Available Technology for Effluent Treatment in the Metal Casting Sector[1].

Capital and operating costs were estimated for the implementation of the appropriate BAT options at each of the Ontario metal casting plants. In all cases the costs are based on the plants as they existed in January, 1992.

Technology Train Costs and Attainable Loadings

The BAT consultant estimated the capital and operating costs of applying each of the identified technology train options to Ontario plants. Performance data, attainable loadings, capital and operating cost estimates for each plant are summarized in Tables 4.1 to 4.3.

Capital costs for the various technology train options were calculated considering all of the site-specific information available. Cost estimates were prepared using budget grade estimates of equipment items received from vendors, as well as available library data. Major equipment items were identified, their approximate sizes specified, and plant layouts and site plans were consulted to determine probable locations for major structures.

Equipment and material cost, installation cost, facilities/structure cost and land purchase cost are specified in the cost estimates of the BAT report[1]. Engineering cost is assumed at 12 percent of the basic cost and other indirect costs are assumed at 30 percent of the basic cost. Operating and maintenance costs include chemicals, materials, services, labour, and equipment maintenance costs.

The Dry Processes Category

The BAT#1 option consists of the treatment technologies presently in use at the five Ontario plants in the Dry Processes Category, namely: oil/water separation and sand and/or carbon filtration.

The BAT#2-5 option focused on total recycle of the cooling water discharges.

Plants in the Dry Processes category will not be limited, because they only discharge non-contact cooling water. However, they will be subject to assessment monitoring in order to ensure that their effluent is contaminant free.

The Wet Processes Category

Considering that there was a significant difference between the two BAT options (BAT#1 and BAT#2-5), identified for the plants in the Wet Processes Category, in performance as well as in cost, the consultant was asked to develop the options in between these two. Therefore, in addition to the demonstrated technologies identified in BAT#1 and BAT#2-5 plants, four more options were developed, consisting of various components of the BAT#2-5 technology[1]. The consultant, however, indicated that the specific technology train configurations for these options were not demonstrated. Consequently, these four options could not be considered during the limit setting process, although the economic assessment was completed on the two more realistic options (BAT#2A and BAT#2B).

BAT #1 (Best in Ontario)

The General Motors plant in St. Catharines was identified as the BAT#1 (Best in Ontario) plant for this Category. The main treatment technologies associated with this BAT plant were as follows:

1. Suspended solids removal using flocculation/ coagulation and clarification.
2. Partial biological treatment (RBC).
3. Oil removal/skimming.

Table 4.1 briefly summarizes the performance data, the estimated loadings and cost of the BAT#1 option for the Wet Process Category if the technology train was retrofit at each plant.

Table 4.1
BAT #1 Performance Data, Estimated Loadings and Cost
Wet Processes Category

Parameter	BAT #1 Performance (g/tonne)	BAT #1 Estimated Loadings (kg/day)	
		General Motors	Ford Motor
Total Cyanide	0.433	0.653	0.280
Ammonia plus Ammonium	52	78.4	33.6
Total Phosphorus	7.1	10.7	4.59
Total Suspended Solids	1,450	2,190	937
Aluminum	49.1	74.0	31.7
Copper	0.51	0.769	0.329
Zinc	35.3	53.2	22.8
Phenolics (4AAP)	4.31	6.50	2.78
Flow (m^3/tonne)	90	90	90
Capital Cost ($x1000)	-	0	920
O & M Cost ($x1000/year)	-	0	70

BAT 2-5 (Best in the US and the World)

Foundry No. 1[a] in the USA was identified in the BAT study as the facility best satisfying the criteria for BAT#2 through BAT#5. The main treatment technologies associated with this BAT plant were as follows:

1. Clarification, cooling and recycle of all process effluents (from dust collectors, scrubbers, sluicing and slag quenching).

2. Collection, evaporative cooling and recycle of most non-contact cooling waters.

3. Collection and recycle of storm water runoff from outside process and/or material storage areas.

5. Biological (extended aeration) treatment of the blowdown from recycle systems with alum addition to remove mixed liquor suspended solids and phosphorus.

6. Filtration of the clarifier effluent (following biological treatment).

7. Ion exchange of the final effluent using a selective resin for heavy metals polishing.

Table 4.2 briefly summarizes the performance data, the estimated loadings and cost of the BAT#2-5 option for the Wet Process Category if the technology train was retrofit at each plant.

<u>The Haley Industries Category</u>

Haley Industries was identified by the BAT consultant as the Best in Ontario (BAT#1) in that Category.

The main treatment technologies associated with this BAT plant were as follows:

1. Biological (extended aeration) treatment.

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[a] The foundries in the U.S.A. requested anonymity.

Table 4.2
BAT #2-5 Performance Data, Estimated Loadings and Cost
Wet Processes Category

Parameter	BAT #2-5 Performance (g/tonne)	BAT #2-5 Estimated Loadings (kg/day)	
		General Motors	Ford Motor
Total Cyanide	0.008	0.012	0.005
Total Phosphorus	2.0	3.01	1.29
Total Suspended Solids	1.8	2.71	1.16
Aluminum	0.006	0.009	0.004
Copper	0.002	0.003	0.001
Zinc	0.12	0.180	0.077
Phenolics (4AAP)	0.004	0.006	0.002
Flow (m^3/tonne)	2	2	2
Capital Cost ($x1000)	-	38,600	26,310
O & M Cost ($x1000/year)	-	1,820	1,000

2. Silver recovery from X-Ray processing effluents.

3. Chemical reduction of hexavalent chromium.

4. Chemically assisted flocculation and coagulation.

5. Activated carbon adsorption.

Table 4.3 briefly summarizes the performance data, the estimated loadings and cost of the BAT#1 option for the Haley Industries Category.

Table 4.3
BAT #1 Performance Data, Estimated Loadings and Cost
Haley Industries Category

Parameter	BAT #1 Performance (g/tonne)	BAT #1 Estimated Loadings (kg/day)
	Haley Industries	
Total Cyanide	75.0	0.203
Ammonia plus Ammonium	1,750	4.73
Total Phosphorus	130	0.351
Total Suspended Solids	15,700	42.4
Aluminum	130	0.351
Copper	34.0	0.092
Silver	21.0	0.057
Zinc	49.0	0.132
Phenolics (4AAP)	1.50	0.004
Flow (m^3/tonne)	48	48
Capital Cost ($x1000)	-	820
O & M Cost ($x1000/year)	-	0

4.2 REFERENCES

1. Beak Engineering Limited. (1992). Best Available Technology for Effluent Treatment in the Metal Casting Sector. Toronto, Ontario. ISBN 0-7778-0564-2

ECONOMIC ASSESSMENT

CHAPTER 5

OF THE

DEVELOPMENT DOCUMENT

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5.1 ANALYTICAL PROCEDURES AND ISSUES

Analytical Steps

The economic analyses presented in this section follow a standard work plan which is employed in all economic assessments of MISA regulated industrial sectors[1]:

1. With available technical information generate cost functions for each plant that show the costs of increasingly stringent levels of pollution reduction and that identify where large cost increases yield little additional reductions in pollution loadings.

2. Compute cost-effectiveness measures of each technology combination used in the cost function to determine which technically feasible levels of abatement are most cost-effective.

3. Analyze the ability of the industry and its constituent companies to pass on potential regulatory costs as increased product prices or to reduce input expenses in order to offset abatement costs.

4. Analyze effects on the competitive position of the regulated Ontario sector and its constituent companies as a result of the estimated potential regulatory-induced costs.

5. Assuming that no costs can be passed on as higher prices, evaluate the effects of estimated MISA-related costs on the past and future financial position of the companies in the sector and individual plants or production units, to the extent that data are available.

6. Where relevant, show the implications for small businesses that may be subject to the regulatory requirements[a].

7. Address the issues peculiar to each industrial sector as identified by the JTC or its subcommittees.

As specified in the MISA Issue Resolution Committee Reports[2], financial assessments of the implications of potential regulatory-induced costs will be carried out at the level of the sector, the company and the plant, where data are

[a] A small business is defined as having 100 or less employees and/or gross annual revenues of $1 million or less.

made available. Published financial and other relevant types of data are available from Statistics Canada and from the financial reports of some companies.

The analyses presented in this chapter will show the costs and pollutant removals for each technology combination at each plant. They also show which technology combination achieves the reductions at lowest unit cost. However, results of financial assessments do not reveal how much abatement or pollution removal ought to be achieved. Financial impact assessments do indicate potential financial consequences for individual companies which can be used in making an informed choice among options.

5.2 COST-EFFECTIVENESS ANALYSES

The technologies postulated for each plant have been described elsewhere in the chapter. Parameter removals were estimated for 13 pollutant parameters: seven "conventional pollutants"; total suspended solids (TSS), total phosphorus, Biochemical Oxygen Demand (BOD), ammonia plus ammonium, phenolics, nitrate plus nitrite and Dissolved Organic Carbon (DOC) and 6 "non conventional" parameters; aluminum, chromium, copper, zinc, silver and cyanide. Many other parameters beside these 13 are discharged by metal casting plants and the technology combinations postulated at each plant are expected to remove a number of these other parameters. Therefore, parameter removal estimates presented are likely to be underestimates of the actual results.

Because many different parameters may be reduced by each combination of technologies and because costs of technology trains cannot be allocated to individual parameters, parameter loadings reduced must be summed in order to compare the costs and the results of one BAT option with another and to compare cost-effectiveness measures.

Simple addition of the mass of parameters being discharged or released (i.e. kg/year) imputes an equal weighting (i.e. weighting of 1) to each parameter. However, this procedure should not be interpreted as equating the toxicity or the damage potential of each parameter[b].

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[b] Two potential contaminant weighting schemes were investigated by the Ministry:

1. The Copper Standard (developed by the US EPA) which provided weighting factors based on human and aquatic life exposure; and

Initial loadings of pollutants being discharged from the plants were calculated as long-term average (LTA) in kilograms per year from data collected during the MISA monitoring program period: May 1, 1990 to April 30, 1991. Potential loading reductions at each plant resulting from each technology combination were calculated as the difference between the initial annual LTA loading and the predicted LTA loading achievable by the technology postulated under each BAT option.

"Budget grade" estimates of capital and operating and maintenance costs in January 1992 dollars were generated by BAT consultant for implementation of each technology combination at each plant. The BAT consultant identified major equipment items and approximated sizes or specific capacities. Plant layouts and site plans were then consulted to determine probable locations for major structures. According to the BAT consultant[3], "*The degree of process and facility definition and the degree of site detail available for this exercise was consistent with producing an estimate accuracy of +20 to +30 to -20 percent*". Therefore, estimates produced by the BAT consultant are used with the knowledge that these costs may be understated by as much as 30% or overstated by as much as 20%.

In order to compare the aggregate costs of the various technology combinations within a plant and among plants, one-time capital costs must be added to recurring (annual) operating costs. In this report, estimates of capital costs are annualized over a period of 10 years at a 12% before-tax interest rate and then added to before-tax operating costs to show a "typical" annual expenditure for the abatement program. This "before-tax" cost estimate also represents the cost to society as a whole.

2.Weights based on the Ontario Provincial Water Quality Objectives and Guidelines.

Application of weights derived from these standards were found to be ambiguous or inconsistent. Consequently, no weights have been applied in this assessment because all such schemes involve value judgements of the analysts or agency who choose and apply the weights and do not necessarily represent the views of other interested parties or the "public" as a whole.

Therefore, contaminant loadings are not weighted in this report but the absolute quantity loadings of various parameters are summed for comparative purposes and for computing cost-effectiveness.

To compute the portion of "after-tax" annualized costs that are actually borne entirely by the regulated company, total "before-tax" annualized costs are multiplied by a factor 1-T, where T is the prevailing effective corporate tax rate of 40%.[c]

Interest rates used for computations in this report are somewhat higher than market rates that prevailed during late 1992 and 1993. These higher interest rates push cost estimates into the higher range of the uncertainty limits noted earlier.

BAT Options and Cost Estimates

Each of the combinations of technologies or "technology trains" that are postulated for each plant are listed in Tables 5.1 and 5.2 along with their associated capital, O&M and annualized costs, and estimated final loadings after abatement.

Abatement costs vary from one plant to another because plants have different initial flow rates and effluent qualities. Consequently, the application of similar treatment technologies will yield different cost estimates at different plants because of site-specific differences in the ability to modify processes and the ability to adapt treatment systems to each plant. Moreover, if a plant already implemented the technology concerned, or achieved equivalent effluent quality, because of its inherent process and/or because of prior expenditures, it is shown as having a zero cost.

---

[c] The general annualization formula is:

$$TAC = O\&M \times (1-T) + K \times (r/(1-(r+1)^{-n})) \times (1-T)$$

where:

TAC	=	Total Annualized Cost of Abatement
O&M	=	Operating and Maintenance Costs
T	=	Income Tax Rate
K	=	Capital Cost
r	=	(Real) Discount or Interest Rate
n	=	Life of Abatement Equipment or System

When T = 0, TAC represents the "before-tax" cost of the BAT Option which is also the cost to society; when T > 0, TAC represents the "after-tax" cost which is borne by the polluter.

The rate of interest used for the analyses is somewhat higher than interest rates being offered during the spring of 1993. If rates continue to remain at this level, annualized costs reported in this study may be over-estimated.

Table 5.1
BAT Options and Cost Estimates
Ford Motor Company

FORD	FINAL LOADINGS SUMMARY										COSTS			
	Regulated Parameters				Non-Conventionals			Total Parameters	Total Conventional Parameters	Total Non-Conventional Parameters	Capital	O&M	After-tax Annualized	Before Tax Annualized
	Phenolics kg/yr	Oil & Grease kg/yr	TSS kg/yr	BOD kg/yr	Aluminum kg/yr	Zinc kg/yr	Cyanide kg/yr	kg/yr	kg/yr	kg/yr	$ 000's	$ 000's/yr	$ 000's/yr	$ 000's/yr
Initial loadings	6,425	372,760	22,296	93,951	23,232	26,122	665	545,451	495,432	50,019				
LIMIT OPTIONS:														
BAT #1														
COAG+CLAR+Pt.BIO+OIL	1,018	341,802	7,709	66,680	11,567	2,826	364	431,966	417,209	14,757	920	70	139.7	232.8
BAT #2A														
COAG+CLAR+Pt.BIO+RECYC+OIL	212	242,713	4,273	32,130	7,541	94	47	287,010	279,328	7,682	10,260	310	1,275.5	2,125.9
BAT #2B														
COAG+CLAR+NON CON+STORM+X-AER(alum) +CLAR+FILT+ION+OIL	3	240,357	6,787	2,121	4,713	28	38	254,046	249,268	4,779	12,610	800	1,819.1	3,031.8
BAT #2-5														
COAG+CLAR+NON CON+STORM+OIL +X-AER(alum)+CLAR+FILT+ION	1	424	N/A	N/A	1	28	2	431	425	32	26,310	1,000	3,393.9	5,656.5

NOTES:
Limits and Final loadings based on Monitoring Production rate of 650 tonnes/day
N/A=Estimate not available

TREATMENT TECHNOLOGIES

COAG=Chemically Assisted flocculation/coagulation
OIL=Oil removing/skimming basin
NON-CON=Evaporative cooling and recycling of non-contact cooling water
STORM=Collection and recycle of storm runoff
FILT=Filtration
Pt. Bio=Partial Biological Treatment of Phenolics
CLAR=Clarification cooling and recycle of process effluent
X-AER(alum)=Extended aeration treatment with alum
ION=Ion exchange

SOURCE: WRB TABLES, EFFLUENT LIMITS OPTIONS
BAT REPORT, BEST AVAILABLE TECHNOLOGY FOR EFFLUENT TREATMENT IN THE METAL CASTING SECTOR

Table 5.2
BAT Options and Cost Estimates
Haley Industries Ltd.

HALEY IND.	FINAL LOADING SUMMARY													COSTS			
	Regulated Parameters											Total Parameters	Total Conventional Parameters #	Total Non-Conventional Parameters @	Capital	O&M	After Tax Annualized	Before Tax Annualized
	Phenolics	Ammonia +A	Conventionals TSS	BOD	Phosphorus	Aluminum	Zinc	Non-Conventionals Cyanide	Copper	Silver	Chromium							
	kg/yr	kg/yr	kg/yr	kg/yr	kg/yr	kg/yr	kg/yr	kg/yr	kg/yr	kg/yr	kg/yr	kg/yr	kg/yr	kg/yr	$ 000's	$ 000's/yr	$ 000's/yr	$ 000's/yr
Initial loadings	1.5	1,703	15,317	20,254	127	123	48	73	33	21	47	35,844	35,572	272				
LIMIT OPTIONS:																		
MISA MONITORING Blo/Chem. Red./Coag. /A.C.Filt./Silver Rec.	1.5	1,703	15,317	20,254	127	123	48	73	33	21	47	35,844	35,572	272	0.0	0.0	0.0	0.0
POST-MISA MONITORING Blo/Chem. Red./Coag. /A.C.Filt./Silver Rec.	1	2,029	28,106	20,254	52	137	39	N/A	35	20	35	48,628	48,361	267	30.0	0.0	3.2	5.3
CERTICATE OF APPROVAL Blo/Chem. Red./Coag. /A.C.Filt./Silver Rec.	3	N/A	884	814	N/A	56	20	N/A	27.0	27.0	24	1,857	1,701	155	820.0	0.0	87.1	145.1
RECOMMENDED OPTION Blo/Chem. Red./Coag. /A.C.Filt./Silver Rec.	1	1,703	884	814	52	56	20	73	27	20	24	1,848	1,700	148	820.0	0.0	87.1	145.1

NOTES:
Limits and Final loadings based on MISA Production rate of 2.7 tonnes/day
N/A=Estimate not available
Total Conventional Loadings do not include Ammonia and Phosphorus
@ Total Non-Conventional Loadings do not include Cyanide

Blo = Biological treatment
Chem. Red. = Chemical reduction
Coag. = Chemically assisted flocculation/coagulation
A.C.Filt. = Activated carbon filtration
Silver Rec. = Silver recovery

SOURCE: WRB TABLES, EFFLUENT LIMITS OPTIONS
BAT REPORT , BEST AVAILABLE TECHNOLOGY FOR EFFLUENT TREATMENT IN THE METAL CASTING SECTOR

Figures 5.1 and 5.2 show aggregate final loadings of each parameter listed in the BAT consultant report as treatable, plotted against total annualized costs for each BAT Option or technology train for Ford Motor Company and Haley Industries. Ford currently emits about 550 tonnes per year of the listed parameters into the Detroit River. BAT#1 option reduces 20.8% of the total parameters loadings in Ford's effluent. By undertaking BAT#2A and BAT#2B, Ford achieves 26.6% and 6.0% reduction in total parameters loadings, respectively. Based on the BAT#2-5 option, the maximum reduction that is technically achievable for Ford is 99.9% (the minimum loading of the listed parameters is 0.5 tonnes).

Haley discharges about 36 tonnes per year into McClaren Creek which runs into the Ottawa River. Based on the Recommended Option, the maximum reduction that is technically achievable for Haley Industries is 94.8% (the minimum loading of the listed parameters is 1.8 tonnes).

Figure 5.1

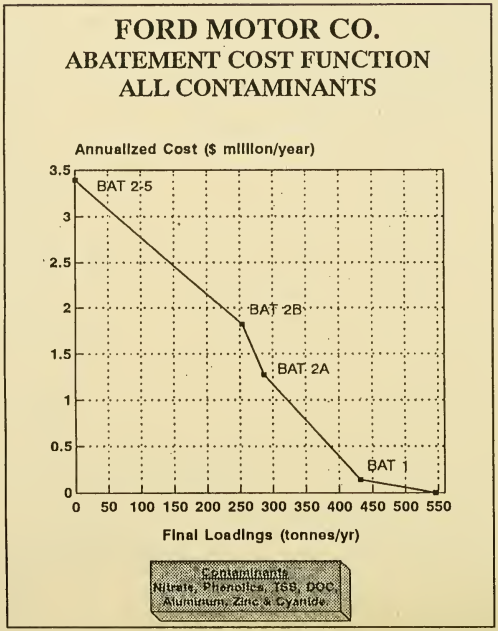
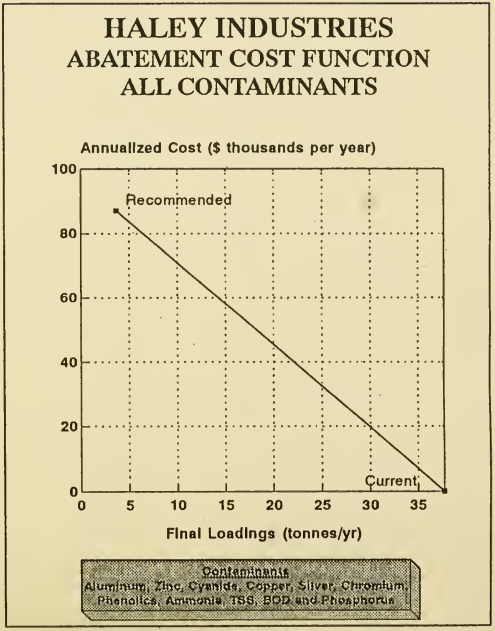


Figure 5.2



Initial and final loadings of non-conventional and conventional parameters are graphed against annualized costs in Figures 5.3 to 5.6. At the plant level, Figures 5.3 and 5.5 indicate that Ford could achieve a final non-conventional loading of 32 kg/yr or a reduction of over 49,900 kg/yr (99.9% reduction), and a conventional loading of 425 kg/yr or a reduction of over 495,000 kg/yr (99% removal). Figures 5.4 and 5.6 indicate that Haley could achieve final non-conventional loading of 148 kg/yr or a reduction of 124 kg/yr (45.6% removal) and a conventional loadings of 1,700 or a reduction of up to 33,870 kg/yr (95.2% removal).

Cost Effectiveness of Abatement Options

In terms of the ability to remove all parameters, each BAT option that can be applied at Ford is least cost, in that, the annualized cost of each option is the lowest possible to achieve the given amount of parameters removed.

Each of the remaining technology trains is presumed to be the least-cost option to achieve the specified levels of parameter removal, up to the level achieved by the highest cost technology train. Thus, in terms of parameter removal, the BAT#2-5 option for Ford Motor Co. and Recommended option for Haley appear to be the "best available technologies" to achieve the highest degree of parameter removal at least cost.

A decision rule is required to narrow down the number of options to be examined for further analyses. One approach is cost-effectiveness analyses. Cost-Effectiveness analysis is a comparative economic tool used to assess different technical options to determine which is better. Alternative courses of action are contrasted in terms of their costs and effectiveness in attaining a specific objective[4].

Figure 5.3

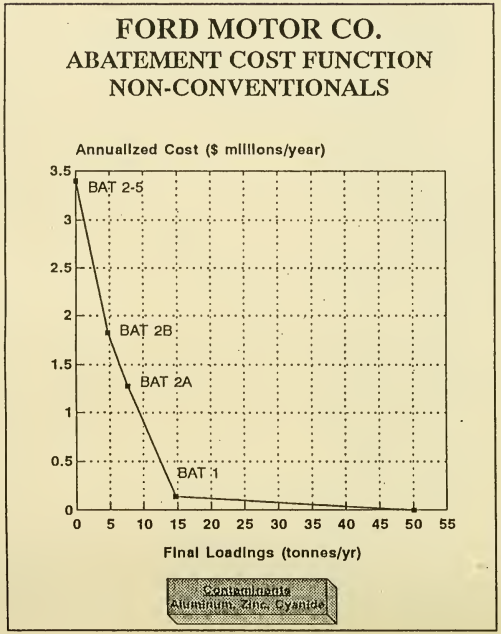


Figure 5.4

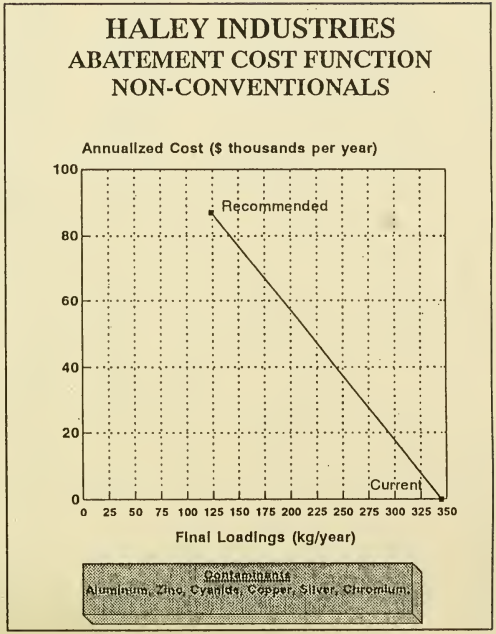


Figure 5.5

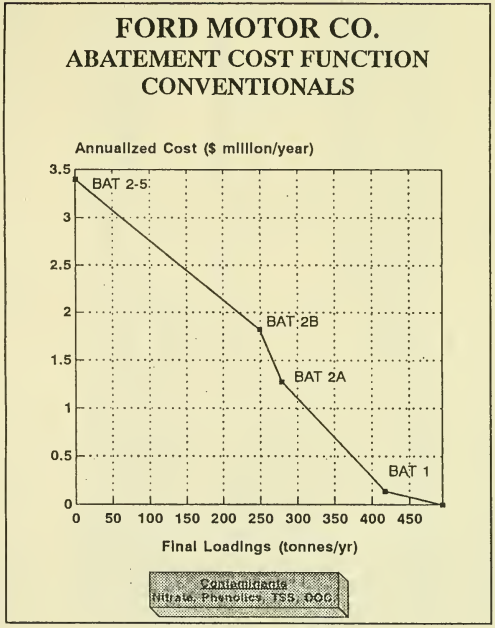


Figure 5.6

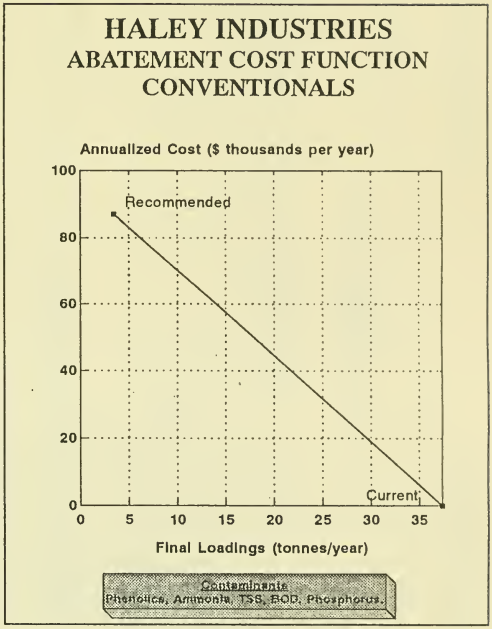


Table 5.3
Costs per Kilogram Removed
$/kg/year

FORD MOTOR COMPANY			
BAT Option	Total Parameters	Conventional Parameters #	Non-Conventional Parameters @
BAT#1 COAG + CLAR + Pt. BIO + OIL	$1.22	$1.77	$3.93
BAT#2A COAG + CLAR + Pt. BIO + RECYC + OIL	$4.41	$5.28	$26.83
BAT#2B COAG + CLAR + NON CON + STORM + X-AER + CLAR + FILT + ION + OIL	$6.24	$7.39	$40.18
BAT#2-5 COAG + CLAR + NON CON + STORM + OIL + X-AER + CLAR + FILT + ION	$6.23	$6.86	$67.86

NOTES:
Final loadings based on Monitoring Production rate of 650 tonnes/day

TREATMENT TECHNOLOGIES
COAG = Chemically Assisted flocculation/coagulation
OIL = Oil removing/skimming basin
Pt. Bio = Partial Biological Treatment of Phenolics
CLAR = Clarification cooling and recycle of process effluent
NON-CON = Evaporative cooling and recycling of non-contact cooling water
STORM = Collection and recycle of storm runoff
FILT = Filtration
X-AER(alum) = Extended aeration treatment with alum
ION = Ion exchange

SOURCE: WRB TABLES, EFFLUENT LIMITS OPTIONS.
BEST AVAILABLE TECHNOLOGY FOR EFFLUENT TREATMENT IN THE METAL CASTING SECTOR

HALEY INDUSTRIES			
BAT Option	Total Parameters	Conventional Parameters #	Non-Conventional Parameters @
MISA Monitoring Bio/Chem.Red./Coag./AC. Filt./Silver Rec.	$0	$0	$0
Proposed Certificate of Approval Bio/Chem.Red./Coag./AC. Filt./Silver Rec.	$2.56	$2.57	738.14
Recommended Option Bio/Chem.Red./Coag./AC. Filt./Silver Rec.	$2.56	$2.57	$696.80

NOTES:
Final loadings based on MISA Production rate of 2.7 tonnes/day
Total Conventional Loadings do not include BOD, Ammonia and Phosphorus
@ Total Non-Conventional Loadings do not include Cyanide

SOURCE: WRB TABLES, EFFLUENT LIMITS OPTIONS.
BEST AVAILABLE TECHNOLOGY FOR EFFLUENT TREATMENT IN THE METAL CASTING SECTOR

The cost per unit of pollutant removed (or average cost) is one measure of cost effectiveness. Table 5.3 displays the annualized cost per kilogram of pollutant removed for each BAT option and each parameter grouping (conventional and non-conventional). For Ford, BAT#1 option represents the lowest cost per kilogram per year removed for each parameter grouping.

For Haley, the Recommended option and the proposed Certificate of Approval option have identical per kilogram costs for the removal of total contaminants and conventional contaminants. This situation arises due to a fact that a number of the final loadings associated with the Certificate of Approval option are used in the creation of the Recommended option. However, based on average cost per kilogram of non-conventional contaminants removed, the Recommended option is more cost-effective option for Haley.

Another method of measuring cost-effectiveness is to calculate the average incremental cost per incremental unit of pollutant removed in achieving successively higher levels of reduction. Table 5.4 displays the incremental cost per unit of pollutant removed for each parameter grouping. Again, BAT#1 option is associated with the lowest average incremental cost for each parameter grouping at the Ford plant. The reduction of 20.8% of the total parameters at Ford by using BAT#1 option is achieved at an average cost of just over $1 per kg . By undertaking BAT#2A, Ford achieves an additional 26.6% reduction in total parameters at an average cost per kg removed of about $7. The average incremental cost per incremental kg removed of undertaking BAT#2B (additional 6.0% reduction) and BAT#2-5 options (additional reduction of 46.5%) are approximately $20 and $6, respectively. This is a result of the large increase in cost associated with undertaking BAT#2B and BAT#2-5 options without commensurate reductions when compared with BAT#1 option.

At Haley Industries, by using the Recommended option, the maximum reduction of 94.8% of the total parameters is achieved at an average cost of $2.56 per kg.

In summary, application of BAT#1 option at Ford and Recommended option at Haley represent the most cost-effective scenario in terms of the lowest cost per kg removed of parameter groupings. This combination of BAT Options and the resulting costs and removal estimates will be referred to as the "Most Cost-Effective" scenario in subsequent sections.

Table 5.4
Incremental Cost per Incremental
Kilogram Removed
$/kg/year

FORD MOTOR COMPANY			
BAT Option	Total Parameters	Conventional Parameters #	Non-Conventional Parameters @
BAT#1 COAG + CLAR + Pt. BIO + OIL	$1.22	$1.77	$3.93
BAT#2A COAG + CLAR + Pt. BIO + RECYC + OIL	$6.95	$7.30	$146.20
BAT#2B COAG + CLAR + NON CON + STORM + X-AER + CLAR + FILT + ION + OIL	$20.21	$22.14	$232.51
BAT#2-5 COAG + CLAR + NON CON + STORM + OIL + X-AER + CLAR + FILT + ION	$6.21	$6.33	$331.75

NOTES:
Final loadings based on Monitoring Production rate of 650 tonnes/day

TREATMENT TECHNOLOGIES
COAG = Chemically Assisted flocculation/coagulation
OIL = Oil removing/skimming basin
Pt. Bio = Partial Biological Treatment of Phenolics
CLAR = Clarification cooling and recycle of process effluent
NON-CON = Evaporative cooling and recycling of non-contact cooling water
STORM = Collection and recycle of storm runoff
FILT = Filtration
X-AER(alum) = Extended aeration treatment with alum
ION = Ion exchange
SOURCE: WRB TABLES, EFFLUENT LIMITS OPTIONS.
BEST AVAILABLE TECHNOLOGY FOR EFFLUENT TREATMENT IN THE METAL CASTING SECTOR

HALEY INDUSTRIES			
BAT Option	Total Parameters	Conventional Parameters #	Non-Conventional Parameters @
MISA Monitoring Bio/Chem.Red./Coag./AC. Filt./Silver Rec.	$0	$0	$0
Proposed Certificate of Approval Bio/Chem.Red./Coag./AC. Filt./Silver Rec.	N/A	N/A	N/A
Recommended Option Bio/Chem.Red./Coag./AC. Filt./Silver Rec.	$2.56	$2.57	$696.80

NOTES:
Final loadings based on MISA Production rate of 2.7 tonnes/day
N/A = Estimates not available
Total Convantional Loadings do not include BOD, Ammonia and Phosphorus
@ Total Non-Conventional Loadings do not include Cyanide
SOURCE: WRB TABLES, EFFLUENT LIMITS OPTIONS.
BEST AVAILABLE TECHNOLOGY FOR EFFLUENT TREATMENT IN THE METAL CASTING SECTOR

5.3 ABILITY OF THE ONTARIO METAL CASTING COMPANIES TO INCREASE PRICES

The Potential to Increase Product Prices

The ability of a company to control product prices depends on:

- the elasticity of demand for its products;
- the structure of the market it sells to and competes in;
- prevailing market demand conditions (i.e. growing or contracting);
- International trade barriers or the lack thereof; and
- capacity utilization.

How each factor contributes to or detracts from this ability is discussed below.

Price Elasticity

Demand for a product is price inelastic if, all other things held equal, a 1% increase in price leads to a less than 1% decrease in the quantity of that product consumed. Inelastic demand for a product allows the producer to increase prices in the short run without experiencing a decrease in revenue. As long as costs do not rise at the same time, the company's profits will increase as well.

Price elasticity of Ontario metal casting products depends on the availability of substitutes and on the ability or willingness of consumers to reduce consumption of the good or service in question. Substitution in the case of the Metal Casting Sector can take two forms. First, substitution away from the good being regulated to a good not being regulated which serves the same purpose. Second, substitution away from a company subject to regulation to one not subject to regulation which produces the same good.

Substitution away from metal casting products to other materials that provide similar properties at a lower unit cost has been taking place in the industry. These substitute materials include plastics, ceramics, powdered metals and composite materials[5].

Furthermore, since only two of the 159 active companies in the province are subject to limits regulation, it is relatively easy for customers to substitute away from these companies to non-regulated companies.

Structure of Markets

Important structural and organizational characteristics of an industry and its markets include the number of buyers and sellers and the market shares of the largest companies. If there are many buyers and sellers and each company controls only a small portion of sales or production capacity, i.e. <5 percent, no single company can affect a change in prices by its own actions. Such a market or industry is termed competitive and participants have little or no capability to set prices independently.

By contrast, if a small number of companies supply a given market, with one or two companies commanding a primary portion of market share (i.e. 25% or more) the situation is known as an oligopoly. Dominant companies in this type of market may have sufficient market power to set prices through "price leadership" or by tacit agreement amongst all competitors.

A market or industry dominated by a single supplier company is monopolistic. Within limits imposed by demand conditions for the product or service in question (eg. price elasticity), the monopoly company can control prices in that market. Monopoly producers have the greatest ability to pass on cost increases as higher prices but, depending on price elasticities, price increases can result in reduced demand for the monopolist's output.

Classification of a particular market or industry as competitive, oligopolistic or a monopoly depends on the number of companies that could enter a market as well as those currently involved in it. The fewer the number of suppliers to a market, the more concentrated it is and the greater the apparent ability of companies to recover increased costs by raising prices.

The Herfindahl Index is a measure of industry concentration that is defined as the sum of the squares of the market shares of each enterprise in an industry. An index value of 1 signifies a perfect monopoly where one company controls 100% of the market share. A market with four companies each having equal market shares (25% each) would have a Herfindahl index of 0.25%. An index value close to 0 signifies a perfectly competitive industry which consists of many enterprises, each of which has an equal market share.

Table 5.5
Enterprise Concentration Measures

Concentration of Shipments of the Four Largest Companies (C4):

	1983	1984	1985	1986
Iron Foundries	49.1	49.7	48.6	49.7
Other Metal Casting[1]	34.8	35.5	36.6	32.0

Concentration of Shipments - 1986

	C4	C8	C12	C16	C20	C50
Iron Foundries	49.7	62.8	72.4	78.5	82.2	96.2
Other Metal Casting	32.0	49.2	60.8	70.9	78.4	97.0

Herfindahl Measures - 1986

	Shipments	Value Added	Employment
Iron Foundries	0.1100	0.1346	0.0468
Other Metal Casting	0.0430	0.0456	0.0489

[1] Other Metal Rolling, Casting & Extruding Industry
Source: Statistics Canada Catalogue 31-402

Statistics Canada[6] reported a Herfindahl Index for shipments of about 0.11 for the Canadian iron foundries industry and a value of 0.04 for the less concentrated Other Metal Casting, rolling and Extruding industry (see Table 5.5). By comparison, the automobile manufacturing sector, which includes Japanese and European companies as well as the North American "Big Three", recorded the highest Herfindahl Index of 0.35. The Index for another relatively concentrated Canadian industry, iron and steel, was close to 0.2.

Another measure of industrial concentration is the percentage of total shipments made by the 4 largest companies in an industry (C4). The 4-company shipments concentration for the Canadian iron foundry industry is 49.7% and for the other metal casting industry is 49.2% as compared to the 46% weighted average for Canadian manufacturing industries as a whole (See Table 5.5).

Moreover, because reported concentration indices do not include export markets and companies that import goods into Canada the market structure for products such as automotive parts and even more competitive than indicated by concentration indices.

Prevailing Demand

Prevailing market demand conditions include trends in the growth or decline in demand for a product, changes in technologies or product specifications and certain institutional arrangements. During periods of rising demand, companies generally have greater opportunities to initiate and maintain price increases. During periods of declining demand, producers are often obliged to cut prices in order to move product.

As noted earlier, Haley produces magnesium and aluminum castings for the aerospace industry. The market for aerospace parts has been considerably reduced since 1990 when it fell by over 4% in Canada alone. This is partly due to reductions in defense spending but also as a result of a slow down in the commercial aerospace industry caused by the recession. In addition, there is surplus capacity in the commercial sector which has reduced demand for replacement airplanes.

The strength of Ford's casted parts market is directly linked to the health of the motor vehicle industry. Adverse business conditions continued for Ford in 1991-2. The slow growth in the Canadian economy was mirrored by a similar situation in the U.S. market which is the recipient of 80% of Ford's production.

The slow economic growth has deterred consumer confidence leading to reduced demand in many markets including the demand for vehicles. As a result, Ford's vehicle sales in the Canadian market totalled 258,700 cars and trucks, down 2,100 units or 1% from 1990. Exports to Ford Motor Company (U.S.) of 371,400 units in 1991 were down 17% from 1990[7].

Furthermore, Ford's market share in Canada for cars declined to 16.8% from 17.1% in 1990, while market share for trucks declined to 24.8% from 28%[8].

Barriers to Trade

Institutional arrangements that affect product pricing include tariffs and non-tariff barriers to international trade. These factors create a competitive advantage for domestic companies protected by tariffs or other barriers. As a result, barriers to trade diminish the number of participants in a market and increase the ability of the participants to pass on cost increases as higher prices.

Most trade in castings is done in the form of finished products, primarily automotive parts. Most trade in automotive parts between Canada and the United States is conducted in a duty-free basis under the terms of either the Canada-U.S. FTA or the Canada-U.S. "Autopact".

Rules of origin requirements under the North American Free Trade Agreement (NAFTA) signed by Canada, the U.S. and Mexico, provide a non-tariff barrier to trade for North American producers. The NAFTA rules of origin section provides that in order to qualify for preferential treatment, automotive goods must contain a specified percentage of North American content (rising to 62.5 percent for passenger automobiles and light trucks as well as engines and transmissions for such vehicles and to 60 percent for other vehicles and automotive parts), effectively limiting competition to domestic producers.

However, under the NAFTA each country will eliminate its remaining tariffs on certain automotive parts immediately and phase out duties on other parts over five years and a small portion over 10 years. This requirement will work to increase competition for Ontario producers from Mexican producers and create pressure to keep casting prices down[9].

The FTA and the NAFTA should reduce the likelihood that safeguard actions will be used unfairly to hinder Ontario exports to the U.S. market. The increased certainty of access may encourage investment in Ontario foundries resulting in improved productivity and product quality, and the opportunity to increase product prices.

Capacity Utilization

Where the production of a product has reached its capacity limit, as measured by the capacity utilization rate, and demand continues to rise, the ability to increase prices is enhanced until increases in capacity are put in place.

Conversely, when demand for a product falls sufficiently to cause one or more suppliers to drop out of a market, a temporary shortage of product may follow which soon disappears after prices increase and consumers adjust their purchases to the new price regime. Generally, the greater the capacity utilization rate, the easier it is to increase prices.

As shown in Table 5.6, metal casting capacity utilization rates for North American producers have fallen in recent years. As capacity utilization decreases, inventories rise, production is reduced and down time is experienced at some plants, curtailing the ability to increase prices.

Table 5.6
Average Foundry Capacity Utilization - Canada & U.S.

1985	1986	1987	1988	1989	1990	1991
64%	N/A	66%	79%	N/A	75%	68%

Source: Foundryman Magazine, Various Issues.

Costing and Pricing Castings

Primary purchasers of Ontario metal castings, the Big Three automakers are demanding that suppliers constantly strive to lower their prices by reducing manufacturing costs, even after they have won a contract. In 1991, the Big Three, set significant price-reduction requirements. GM hoping to reduce its materials budget by $2 billion by 1993 presented its suppliers with its so-called "3-2-2" plan, asking parts makers to reduce prices by 3 percent in 1991, 2 percent in 1992 and 2 percent in 1993. Ford has asked its suppliers to cut costs by 1 percent annually, while improving productivity by 5 percent annually for the next 5 years. Chrysler has set no

absolute figures on cost reduction but has been aggressive in reducing component costs, claiming the process has allowed it to trim $102 million in outlays for parts in recent years[10].

At Haley, there is considerable pressure from customers to reduce prices and enter into long term pricing agreements. This has resulted in many castings selling at reduced prices. As a result of the recession, customers are also reducing the number of vendors they deal with so competition is strong to remain on the vendors list. All input costs at Haley are continually under scrutiny for potential reduction to remain competitive.

Summary

Ontario metal casting plants subject to MISA are heavily dependent on U.S. markets which are subject to increasing competition. Furthermore, the current economic recession has reduce demand for final products and forced Ontario plants to reduce capacity utilization rates and created pressures to reduce prices. The NAFTA will further work to increase competition which generates pressures to keep prices down. These market conditions severely limit the ability of Ontario metal casting plants subject to MISA to pass on abatement costs as increased prices.

5.4 IMPLICATIONS FOR COMPETITIVENESS

Introduction

In his recent study of Canadian competitiveness, Michael Porter aimed criticism at Canadian business, government and labour for Canada's poor competitive performance in recent years. He warned that productivity must improve if Canadians are to raise or even maintain present incomes and standards of living. The federal government echoed this message in its own competitiveness proposals calling on Canadian business and labour to increase investment, particularly in research and development and in education[11].

The main reason that competitiveness has garnered a high profile recently is the deterioration of Canada's competitive position relative to the U.S. since 1985. Evidence of the competitive pressure on Ontario includes the increase in cross-border shopping and the many lay-offs and closures in manufacturing plants across the province. Pressures on

Ontario's manufacturing sector were not only the result of a relatively high Canadian dollar in 1991, weak North American demand and an increase in global competition, but also stemmed from the reduction of tariffs under the Canada-U.S. Free Trade Agreement of January, 1989.

Regulation and Competitiveness

The key factors affecting the competitiveness of Ontario foundries include economies of scale; costs associated with labour, environmental compliance control, transportation and raw materials; superior services; reliable quality; and prompt delivery[12].

According to ISTC, Ontario metal casting plants have been able to compete effectively in most product markets because of their superior customer service, reliable quality and prompt delivery. The just-in-time (JIT) delivery of castings is particularly important to automotive and farm machinery companies and, increasingly, construction projects. This emphasis favours North American producers over offshore competitors.

The most important competitors to Ontario metal casting plants are located in other provinces, primarily Quebec, the U.S., and newly industrialized countries such as Mexico, Taiwan and the Republic of Korea[13].

Most of the provinces, with Ontario, Quebec and British Columbia in the forefront, are developing stricter environmental regulations for control of industrial air emissions and waste water as well as disposal of used foundry sand and other solid wastes.

Ontario's proposed Policy for Management of Excess Soils, Rock and Like Materials focuses specifically on the disposal of spent foundry sand and may lead to cost savings for the industry[14].

Environmental Protection Activities in Other Jurisdictions

To the extent that Ontario environmental requirements are in excess of those applied in jurisdictions where competitors are located, Ontario metal casting plants could be at a competitive disadvantage. Various types of environmental protection requirements in other jurisdictions (including the U.S. and OECD countries) have been reviewed by James F. Hickling Management Consultants (1990) who concluded that:

"In our view, all the jurisdictions examined will continue to impose ever-more stringent regulation of industries' toxic pollutants."

Moreover, the Hickling report states that Canadian-based companies have an advantage relative to their United States counterparts.

"Companies operating in Canada, however, have a significant advantage over their U.S. counterparts in the Canadian federal government's accelerated capital cost allowance that the Canadian companies are permitted on their purchases of equipment for the purposes of pollution abatement and control. U.S. companies have no such comparable program"[15]

Comparing environmental standards and requirements among jurisdictions is not a simple matter. Standards and requirements are stated differently and there are various degrees of legality and enforceability. Moreover, while a nation or a jurisdiction may have strict standards and legislative requirements on the books, enforcement actions, or the lack of them, may result in little or no compliance. While regulatory regimes are not uniform or consistent in type or degree of stringency, there appears to be a general international movement towards higher degrees of regulatory standards and enforcement effort, with a variety of parameters and performance indicators being used to target the same group of environmental problems.

Compounding the difficulties of making precise international comparisons is the fact that standards for existing plants are often different from those for new plants. Moreover, standards or objectives are often not uniform between different products and sub-categories of the same industry. In most jurisdictions, standards for existing establishments are often negotiated on a plant by plant basis within a framework of regulatory targets.

In the United States, Federal effluent guidelines have been developed for the Metal Moulding and Casting Industry by the EPA. Each plant that discharges to surface water must apply to the EPA for a National Pollutant Discharge Elimination System" (NPDES) permit. The industry was subdivided into five categories according to the primary metal cast at each plant: aluminum, copper, ferrous metals, magnesium and zinc.

Within each category, distinct manufacturing or air pollution control segments were identified. Each of these process segments were assigned an allowable loading mass in kg/tonne of metal poured and allowed water use.

Of the five sub-categories in the industry, copper and zinc do not exist in Ontario as direct discharge plants. One problem with this format of regulation is that some process discharges are not regulated. Certain processes in the metal moulding and casting industry are not covered by the regulation because their use was not sufficiently widespread to allow the EPA to characterize the effluent quality or because the effluent source was not specifically associated with casting operations. The magnesium casting sub-sector in the United States was left unregulated as "EPA [has] determined that BPT options considered for the magnesium sub-category are not economically achievable for the sub-category as a whole. One of the two plants was projected to close if even the most basic of treatment was used as the basis of BPT[16].

Another problem with the U.S. regulation is its complexity. The industry base is considerably larger in the U.S. than in Ontario. In order to encompass such a sizable industry, regulation development was forced to be highly complex and required a very large database. In Ontario, there is a much smaller direct discharging industry consisting of two large foundries and five smaller ones. To produce a complex regulation based on the system in the United States to regulate such a small industry is unnecessary.

Standards for plants in other jurisdictions are compared in Table 5.7. Examples of the discharge limits at two U.S. foundries and discharge limits which cover all industrial effluent in Japan and metal industries in Taiwan are compared with those examined for Ford Motor Co. and Haley Industries.

The technologies associated with the BAT#1 option for Ford and the Recommended option for Haley (the most cost-effective options) deliver final loadings in common with limits set in the United States and that are significantly below limits in other jurisdictions.

Stringent demands may impact negatively on Ontario plants' competitive position in that it forces plants to spend relatively more capital on environmental requirements and less on upgrading machinery and equipment needed to improve productivity than their competitors.

Table 5.7
Comparison of Effluent Concentration Limits for Common Parameters
Monthly Average Limits (mg/L)

ATG	PARAMETER	OTHER JURISDICTIONS				ONTARIO	
		JAPAN	TAIWAN	FOUNDRY 1*, INDIANA	FOUNDRY 2*, ILLINOIS**	MCE FORD	MCE HALEY
2	Total Suspended Solids	150	200	10	15	25.9	25
9	Chromium	2	2	N/A	N/A	N/A	1
9	Copper	3	3	0.07	0.028	N/A	1
9	Zinc	5	5	0.44	N/A	0.3	1.5
14	Phenolics	5	N/A	N/A	N/A	0.03	0.05
-	BOD	120	N/A	15	N/A	N/A	25

N/A Not Applicable/Not Found.

MCE Most Cost Effective

* Permission not granted to use name of Foundry.

** Limits for production above 1985 tonnes per day.

However, as competitiveness expert Michael Porter recently reported,

"The conflict between environmental protection and economic competitiveness is a false dichotomy."

In his book, The Competitive Advantage of Nations, Porter finds that the nations with the most rigorous environmental requirements often lead in exports of affected products. According to Porter,

Exacting standards seem at first blush to raise costs and make companies less competitive, particularly if competitors are from nations with fewer regulations. This may be true if everything stays the same except that expensive pollution-control equipment is added.

But everything will not stay the same. Properly constructed regulatory standards, which aim at outcomes and not methods, will encourage companies to re-engineer their technology. The result in many cases is a process that not only pollutes less but lowers costs or improves quality.[17]

5.5 FINANCIAL ASSESSMENTS AND IMPACTS OF BAT OPTION COSTS ON METAL CASTING COMPANIES

Introduction

The financial and economic implications of potential MISA-related abatement costs are analyzed in this section, assuming that all potential water pollution abatement and monitoring costs will be absorbed by the regulated companies. MISA-related costs are added to past financial performance data for the metal casting companies to determine the changes in relevant financial measures and indicators.

Consistent with the draft Issue Resolution Committee Report (June 1990), financial performance data over the past 10 years are used to assess the potential financial effects of the relevant monitoring and abatement costs for the constituent companies or for individual plants.

Comparisons of potential MISA-related compliance costs with expected **future financial performance indicators** constitutes one approach with which to judge the effects of potential regulatory costs. This analytical approach could not be implemented for the Metal Casting Sector because agreed to financial performance forecasts for individual plants or companies are difficult to produce with any degree of certainty or reliability and furthermore, are not available from independent sources.

Analyses presented in this chapter are based on published data from Statistics Canada and the consolidated financial reports of each company. From a public policy perspective, assessments of the implications of increased regulatory costs at the company and the industry (or sector) level are

important and useful for the following reasons:

a. Intra-company transfer prices (that are charged to one division of a company by another division of the same company) for a particular plant may not reflect true market conditions (i.e. prices that a casting plant receives from automobile plants owned by the same company may be below fair market prices);

b. Corporate resources may be available that are not recorded in plant level income statements; and,

c. The company, rather than the plant, would have to raise the funds for implementing regulatory requirements.

However, consolidated, company-level financial data may not accurately represent individual plants because these data include revenues and costs of different business units (i.e. some metal casting companies also manufacture other products) and of different plants and facilities operating outside of Ontario. Consequently, analyses using plant level financial data in addition to company level financial statistics would provide the best overall assessment of financial impacts.

Plant level financial data however, are not available for analysis. Moreover, only those companies for which the Ministry has complete, published financial data for the years 1982 to 1991 were subject to analysis in this chapter.

Insights from financial statements are based on relationships between items on the statements (i.e. creating ratios, percentages) and on trends in these relationships or specific financial indicators (comparative time-series analysis). Incremental regulatory costs may be added to financial statements to determine how ratios, percentages and absolute values of historical financial indicators would change and by what magnitude. While such an approach is useful, several caveats are in order.

First, as noted, financial statements are records of the past. Historical information is frequently used in decision-making. A critical assumption is that future financial performance will on average be similar to historical trends.

Second, ratios and trends serve as "red flags" regarding problem areas. While ratio and trend analyses help identify past and present financial weaknesses of a company, they do not necessarily reveal the underlying cause of the results.

Finally, a single ratio by itself does not fully characterize a company's financial performance just as a single pollution parameter may not accurately represent water quality. Moreover, it is often not possible to judge the relative importance of a given value of a ratio or financial indicator or specific changes in these values. Therefore, an inventory of financial indicators and ratios is needed to fully gauge a company's financial performance. Furthermore, benchmark or threshold values can be defined against which financial indicators can be compared in order to judge and evaluate the importance of specific changes. Thresholds may be based on industry averages, on historical results of a particular company or of competitors or on planned performance levels.

Most companies that own and operate metal casting plants in Ontario are major, national and multi-national corporations so that small business interests are not at stake in this Sector.

Financial Indicators and Thresholds

Effects of incurring the costs associated with the MISA monitoring regulations were evaluated on the basis of changes to three financial indicators: after-tax return on investment or capital employed, capital investment and after-tax profits [18]. These costs are presented in Table 5.8.

After-tax return on investment or capital employed was used because it represents the return that induces owners and investors to keep their capital in a particular enterprise or if returns drop low enough, to move their money to another business that may be more profitable.

Incremental operating costs as a percent of after-tax profits shows the amount that these profits could be reduced by the regulatory requirements. Similarly, the incremental capital costs to comply with regulatory requirements as a proportion of past capital expenditures indicates the proportion of the company's available capital funds that might have to be diverted from other uses.

The U.S. EPA commissioned studies to determine which financial indicators and ratios best predict business failure. Three ratios were found by U.S. EPA contractors to have strong empirical correlation with business failure: return on assets, total debt to total assets and cash flow to total debt.

Table 5.8
Actual and Estimated Monitoring Costs
For Plants Subject To MISA Requirements

Plant	Monitoring Costs	
	Total Capital ($'s)	Total Operating ($'s)
Ford Canada (Windsor)	238,000	218,500
Haley Industries (Haley)	50,000	160,000
Total	$288,000	$378,500

Source: MISA Actual Monitoring Questionnaires
Ontario Ministry of the Environment (December 1989) Monitoring Cost Estimates and Their Implications for Direct Dischargers in the Ontario Metal Casting Industry

An additional 18 financial ratios and indicators were applied in the present analysis to achieve a more comprehensive assessment of the effects of potential MISA-related compliance costs. These financial indicators were obtained from prior MOE experience, US EPA experience and industry recommendations and represent measures of: profitability, solvency, liquidity and efficiency. An annotated list of financial measures, ratios and indicators that are used in the present assessment has been compiled and can be found in Appendix C.

Adjustment Procedure

Total MISA-related capital and operating costs for the Most Cost Effective Removal levels of abatement plus actual or estimated MISA monitoring costs were added to (or subtracted from) appropriate items in the income statement and balance sheet for each company for which data were available.

The "adjustment" procedure consists of the following steps and is explained in more detail in Appendix C:

1. "Before abatement", pro-forma average" income statements and balance sheets were calculated for each company using consolidated financial data over the previous 10 years.

2. "Before abatement" financial indicators and ratios for the 10 year average and the most recent year for which full financial data were available were calculated.

3. Potential MISA costs were added to financial statements for the most recent year (1990), and the 10 year average.

4. "After abatement" financial indicators and ratios for the most recent year and the 10 year average were calculated.

The significance of the resulting ratios and indices may be evaluated two ways:

- the magnitudes of changes between the "before-abatement" and "after-abatement" results; and

- the "after abatement" indicators may be compared with threshold values defined below.

For purposes of the analyses, an assumption had to be made as to how the capital costs of the potential abatement technologies would be financed. For example, all added capital and operating costs may be deducted during a single year to show the absolute worst-case impact if expenses were financed entirely out of current revenues. A more accurate approach would be to assume debt financing of capital costs with operating costs deducted from current revenues.

For purposes of this assessment, it is assumed that the capital costs are financed by debt at 12% per annum over ten years. This is in keeping with evidence on the long-run pre-tax real rate of return in the Canadian manufacturing sector[19].

As discussed in the Issue Resolution Process Committee Document[20] and explained in a report by KPMG Peat Marwick Stevenson and Kellogg[21], there are no widely accepted and unequivocal thresholds by which one may determine whether a particular level of cost or whether specific magnitudes of changes in financial indicators is "economically achievable" for a company or an industrial sector.

In this analysis, the "after abatement" financial indicators are compared with the following types of values to assess financial impact:

a) historical averages for the industry as a whole or for individual companies;

b) threshold values that are recommended and agreed upon by industry and/or financial analysts; or

c) ratios and indicators that were recorded (by a company or the industry as a whole) during the "worst year" in terms of before-tax profit (ie. operating income) over the last nine years.

Financial Implications of MISA Related Costs

Total estimated capital and operating costs for the technologies associated with the Most Cost Effective level of abatement were added to the costs of monitoring at each plant exhibited in Table 5.8 and used to proceed with the analysis.

Analyses presented in this section are based on the assumption that a company can borrow the capital required.

Furthermore, because no benchmarks or criteria were agreed upon regarding threshold values and because plant-level financial data were not available, there is no objective basis for predicting plant closure or company bankruptcies. Judgmental conclusions about company responses to these costs and their effects are left to the reader.

Financial effects of the potential regulatory costs will be mitigated by the income tax system and by the Accelerated Capital Cost Allowance (ACCA). So long as the company has profits against which to claim it, the ACCA can be applied to 25% of pollution control equipment costs in year 1, 50% in year 2 and 25% of these costs in year 3. Moreover, to the extent that taxable profits are reduced by MISA-related costs, the government shares in a reduction in tax revenues by about 40% of the profits reduced. The "after abatement" financial indicators and ratios that are calculated for each company include the mitigating effects of the ACCA where applicable.

"After abatement" indicators and ratios for the most recent year (1991) and for the 1983-1991 average performance values are shown for each company in Appendix C - Tables C.1 and C.2.

Financial impact results for each cost-effective abatement option are discussed first on the nine year average financial data. The implications of recalculated financial indicators using 1991 financial data are discussed next.

Recall that the Cost-Effective (MCE) level of abatement consists of applying technology trains BAT#1 at the Ford plant and Recommended option at the Haley plant.

Financial Consequences of the Most Cost Effective Level of Abatement

Effects of the MCE option on the two companies are presented in Tables C.1 and C.2 and are illustrated in Figures C.1 to C.4 in Appendix C.

Nine Year Average

Changes in the financial performance indicators using nine-year average data ranged from 0% to 3.2%

For example, return on capital was reduced by less than 1% for both companies, and the percentage change in cash flow was reduced by less than 1% for both companies.

In no circumstances did the costs associated with the MCE level of abatement push the financial indicators of a company lower than the recorded performance achieved in the year that operating income was at its lowest between 1983 and 1991, one of the prescribed thresholds in this analysis.

As a percentage of annual capital expenditures, the annualized capital cost of the MCE level represents less than 1% of nine-year annual average capital expenditures incurred by Ford and 9% incurred by Haley.

Table 5.9 lists the estimated changes in after-tax net earnings or profit for each company as result of incurring costs associated with the MCE abatement level. The nine year average after-tax profit would decline by less than 1% for Ford and just over 3% for Haley.

Using nine-year average performance indicators, financial assessment of the impact of regulatory costs associated with the cost-effective options on the two companies were small to negligible in terms of financial performance measures which did not violate threshold values suggested for this analysis.

Table 5.9
Estimated Effects on After-Tax Profit of the Most Cost-Effective Option

FIRM	# OF PLANTS*	1991 SALES	AFTER-TAX PROFIT ($millions)					
			10 YEAR AVERAGE			1991		
		$millions	before abatement	after abatement	percent change	before abatement	after abatement	percent change
FORD CANADA	1	12,174	143.2	142.9	0.2%	-208.9	-209.5	-0.3%
HALEY INDUSTRIES	1	31.2	3.21	3.11	3.1%	1.404	1.303	7.2%

* The number of plants displeyed are the number of direct discharge metal casting mills in Ontario owned by the company. It is not these plants alone thet generated the 1991 sales or profits used in other columns.

Most Recent Year

The most recent year, 1991, is also the worst year of operating profit performance for Ford during the 1983-91 period. In the situation where the worst year of operating profit performance is also the most recent year, using the ratio and indicator values of the year in which the operating income was recorded, as thresholds to measure the effects of abatement is no longer valid. The imposition of abatement costs will naturally push current poor financial performance further below "worst year" values.

In this case, the magnitude of changes between "before-abatement" and after-abatement" results provide a useful evaluative tool to judge the significance of each abatement level scenario on data for the most recent year.

Returns on capital were reduced by less than 1% at both companies. Cash flow dropped by less than 1% at Ford and by 4% at Haley.

The estimates in Table 5.9 indicate that losses associated with regulatory costs for Ford, already in a 1991 net-loss position, increase by less than 1%. The larger decrease in net income at Ford relative to the nine-year average is the result

of the fact that no ACCA can be claimed against expenses in years of a financial loss. A profitable company would have available to it substantial mitigation of these effects by means of the ACCA. The decrease in net income associated with the cost effective option at Haley could cause a 7.2% decrease in after-tax profit.

In general, when the financial analysis applies MISA-related costs to financial indicators at the two companies for the most recent year (1991), results are of a similar magnitude as when applied to the nine year average.

Final Perspective

Environmental protection programs are concerned with short-to-medium time horizons (3-5 years) required to implement new programs and with the longer-term (10-20 years) during which program benefits are often realized.

For this reason, effects on both long-term performance (nine-year average) and short term performance (most recent year) were analyzed.

In the short term, both options exacerbate poor financial results to a very small extent (in most cases financial indicators change less than 1%).

In the longer term, the impacts on average long-term performance were small to negligible for the cost-effective options at both companies. If economic performance of the next 10 years are equal to or better than the past decade on average (including the 1990-92 recession), companies in Ontario should be able to implement the MCE level of abatement without violating threshold values suggested for this analysis.

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THE EFFLUENT LIMITS

CHAPTER 6

OF THE

DEVELOPMENT DOCUMENT

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6.1 SELECTION OF PARAMETERS FOR LIMITS

Following the identification of the preferred BAT options[1], the candidate parameters selected for effluent limits were evaluated to determine those parameters for which technically defendable effluent limits could be developed. The evaluation of each candidate parameter is presented in this section.

Wet Processes and Haley Industries Categories

Preliminary List of Parameters for Limits

The 24 parameters with reliable data were reviewed by the BAT consultant and the preferred options were assessed as to their ability to treat each parameter. Each parameter was screened by comparing the average concentration of the parameter in the effluent to the minimum concentration that can be achieved by applying the preferred BAT treatment technology. The following assessment includes the results of the BAT study and the rationale used in accepting or rejecting the parameters as candidates for limit setting:

ATG 2: *Total Cyanide*

Total cyanide was found in the effluents of all three plants, however, at General Motors it was found at very low concentrations. Since metal casting plants do not use cyanide as a process chemical, it is assumed that the cyanide found in some effluents is a byproduct of high-temperature melting processes.

The BAT study[1] found that a number of demonstrated treatment technologies exist for cyanide control, therefore, effluent limits for cyanide have been developed for Ford Motor Company of Canada and Haley Industries.

ATG 4a: *Ammonia plus Ammonium*

Ammonia plus ammonium was found in the effluents of all three plants, however at Ford it was found at very low concentrations. Treatment technologies to remove ammonia plus ammonium were identified in the BAT report, therefore, effluent limits have been developed for General Motors and Haley Industries' discharges.

ATG 4a: *Total Kjeldahl Nitrogen (TKN)*

Total Kjeldahl nitrogen was found in the effluent from Haley Industries. Since the limits have already been developed for the ammonia plus ammonium for Haley Industries, total Kjeldahl nitrogen was not considered further as a parameter relevant for effluent limits setting. Its source is believed to be municipal waste not industrial.

ATG 4b: *Nitrate plus Nitrite*

Nitrate plus nitrite was found in the effluents of all three plants, however, at General Motors it was found at very low concentrations. Since ammonia plus ammonium effluent limit has already been developed for Haley Industries, nitrate plus nitrite parameter was not considered relevant. Effluent limits for this parameter have been developed for the Ford Motor Company of Canada plant because demonstrated treatment technologies exist for the removal of nitrate plus nitrite at the concentrations found in Ford's effluent.

ATG 5a: *Dissolved Organic Carbon (DOC)*

Dissolved organic carbon was identified as a suitable surrogate parameter for chemical oxygen demand (COD) and total organic carbon (TOC). Effluent limits have been developed for the Ford Motor Company of Canada and General Motors.

For Haley Industries, biochemical oxygen demand (BOD) will be limited due to the presence of the biological (extended aeration) treatment process. Biochemical oxygen demand was not on the original list of parameters monitored in the MISA Effluent Monitoring Regulation for this Sector. However, it is considered as a relevant parameter for limits setting because Haley is monitoring for BOD under the old Certificate of Approval.

ATG 6: *Total Phosphorus*

Total phosphorus was found only in the effluent from Haley Industries. A number of demonstrated treatment technologies have been identified for total phosphorus control, therefore, effluent limits have been developed for Haley Industries.

ATG 8: *Total Suspended Solids (TSS)*

Total suspended solids were found in the effluents of all three plants. Suspended solids originate mainly from dust

collection and furnace exhaust scrubbers. The majority of these solids can be removed by primary treatment. Effluent limits have been developed for the Ford Motor Company of Canada, General Motors and Haley Industries plants.

ATG 9: *Aluminum*

Aluminum was found in the effluents of all three plants. The BAT study found that a number of demonstrated technologies exist for aluminum control, therefore, effluent limits have been developed for the Ford Motor Company of Canada, General Motors and Haley Industries.

ATG 9: *Chromium*

Chromium was found in the effluents of Haley Industries and General Motors, however, concentrations of chromium in the effluent from General Motors was low. Demonstrated treatment technology for the removal of chromium exists and chromium effluent limits have been developed for Haley Industries.

ATG 9: *Copper*

Copper was found in the effluents of the Haley Industries and Ford Motor, however, the concentrations found in Ford effluent were low. Technologies for the control of copper in metal casting effluents have been demonstrated on a worldwide basis, therefore, effluent limits have been developed for Haley Industries.

ATG 9: *Lead*

Lead was found only in the effluent of Haley industries. Lead is not permitted to be a part of scrap metal, however, the source of lead in metal casting effluents is usually scrap used in the metal melting process. Soluble lead readily reacts with many common compounds of metal casting effluents to form precipitates.

Although the particular technologies for the removal of lead were identified in the BAT study (e.g. activated sludge, ion exchange), due to the limited occurrence of lead and the low levels detected in the effluents of the three plants, lead was not considered as a parameter for effluent limits setting.

ATG 9: *Silver*

Silver was found only in the effluent of Haley Industries.

Demonstrated technology exists for silver removal, therefore, effluent limits have been developed for Haley Industries.

ATG 9: *Zinc*

Zinc was found in the effluent of all three plants. Demonstrated technologies for the removal of zinc from metal casting effluents exist, therefore, effluent limits have been developed for Ford Motor Company of Canada, General Motors and Haley Industries.

ATG 9a: *Iron and Magnesium*

Iron and magnesium were found in the effluents of all three plants. Iron and magnesium are used as raw materials or alloy additives in most of the metal casting plants. They are usually in particulate form and they are expected to be removed by controlling total suspended solids, therefore, iron and magnesium were not considered for effluent limits setting.

ATG 10: *Antimony, Arsenic and Selenium*

Antimony, arsenic and selenium were found only in the effluent of the Haley Industries plant. Demonstrated treatment technologies for the removal of these three metals from metal casting effluents were not identified, therefore, they were not considered further as parameters for effluent limits setting.

ATG 12: *Mercury*

Mercury was found only in the effluent of the Haley Industries plant. Demonstrated treatment technology for the removal of mercury from metal casting effluents was not identified, therefore, mercury was not considered further as a parameter for effluent limits setting.

ATG 14: *Phenolics (4AAP)*

Phenolics were found in the effluents of all three plants. Phenolics are frequently found in metal casting effluents, particularly in the effluents from plants using sand casting. Sources of phenolics are usually the phenolic-based binders and resins used in the sand casting process.

Demonstrated treatment technologies for the removal of phenolics from metal casting effluents were identified by the BAT consultant, therefore, effluent limits have been developed

for Ford Motor Company of Canada, General Motors and Haley Industries.

ATG 24: *Octachlorodibenzo-p-dioxins (OCDD)*

Octachlorodibenzo-p-dioxins was found in the effluent of the Haley Industries plant. Demonstrated treatment technology for the removal of OCDD from the metal casting effluents was not identified in the BAT report, therefore, OCDD was not considered as a parameter for effluent limits setting.

ATG 30: *Fluoride*

Fluoride was found in the effluents of all three plants. Demonstrated treatment technology for the removal of fluoride from the metal casting effluents was not identified, therefore, fluoride was not considered for effluent limits setting.

Final Parameters for Limits

As a result of the BAT review as to the abilities of the recommended BAT options to treat the selected parameters, 13 of 24 parameters were identified as parameters to be limited. Table 6.1 presents the final list of parameters that will be limited at the three plants in the Metal Casting Sector.

6.2 STATISTICAL APPROACH TO LIMIT SETTING

In Chapter 4, the General Motors plant in St. Catharines was identified as the preferred option for the Wet Processes Category, and the existing technology train at Haley Industries as the preferred option for the Haley Industries Category. The effluent limits, therefore, will be based on the performance data from these two BAT plants. The statistical approach for setting the effluent limits for each parameter, was based on the following steps:

Step 1 The Average Production-Based Flowrates

> The first step in the effluent limit setting process was to calculate the average production-based flowrate (m^3/tonne) for each BAT plant by dividing the average flow (m^3/day) by the average daily production (tonnes/day).

The BAT average production-based flows calculated for the General Motors and the Haley Industries plants are presented in Table 6.2.

Table 6.1
Parameters Selected for Limits

ATG	Parameter	General Motors	Ford Motor	Haley Ind.
1a	Biochemical Oxygen Demand			x
2	Total Cyanide		x	x
4a	Ammonia plus Ammonium	x		x
4b	Nitrate plus Nitrite		x	
5a	Dissolved Organic Carbon (DOC)	x	x	
6	Total Phosphorus			x
8	Total Suspended Solids (TSS)	x	x	x
9	Aluminum	x	x	x
9	Total Chromium			x
9	Copper			x
9	Silver			x
9	Zinc	x	x	x
14	Phenolics (4AAP)	x	x	x

ATG = Analytical Test Group

Step 2 The LTA Concentrations

The second step in the effluent limit setting process was to calculate the LTA concentration for each limited parameter as the arithmetic mean of the performance data.

The LTA concentrations for each limited parameter, expressed in mg/L, for the BAT plants are presented in Table 6.3. They are used in calculating the LTA loadings.

Step 3 The Average Production-Based LTA Loadings

The LTA loading per unit of production (g/tonne) for the parameters to be limited was calculated as the product of LTA concentration (mg/L) and average production-based flowrate (m^3/tonne).

Table 6.2
Average Production-Based Flowrates

BAT Plant	Average Production (tonnes/day)	Average Flowrate (m^3/day)	Average Production-based Flowrate (m^3/tonne)
General Motors, St. Catharines	1510	135,900	90
Haley Industries, Haley	2.7	129	48

Table 6.3
Long-Term Average Concentrations (mg/L)

ATG	Parameter	General Motors	Haley Industries
2	Total Cyanide	0.00482	1.54
4a	Ammonia plus Ammonium	0.578	36.2
4b	Nitrate plus Nitrite	0.364	-
5a	Dissolved Organic Carbon (DOC)	3.14	-
6	Total Phosphorus	-	2.69
8	Total Suspended Solids (TSS)	16.1	325
9	Aluminum	0.546	2.62
9	Chromium	-	0.992
9	Copper	-	0.698
9	Silver	-	0.442
9	Zinc	0.393	1.02
14	Phenolics (4AAP)	0.0479	0.031

The production-based LTA loadings (g/tonne) for each limited parameter for the BAT plants are presented in Table 6.4.

Table 6.4
Average Production-Based LTA Loadings (g/tonne)

ATG	Parameter	General Motors	Haley Industries
2	Total Cyanide	0.433	74.3
4a	Ammonia plus Ammonium	52.0	1740
4b	Nitrate plus Nitrite	32.7	-
5a	Dissolved Organic Carbon (DOC)	283	-
6	Total Phosphorus	-	129
8	Total Suspended Solids (TSS)	1450	15700
9	Aluminum	49.1	126
9	Chromium	-	47.8
9	Copper	-	33.6
9	Silver	-	21.3
9	Zinc	35.3	49.3
14	Phenolics (4AAP)	4.31	1.49

ATG = Analytical Test Group
LTA = Long Term Average

Step 4 The Loading Variability Factors

The loading variability factors (VF) for the parameters to be limited are calculated based on the data from the BAT plants. The variability factors take into account analytical and sampling uncertainty, process and plant variations, treatment process fluctuations that result from changes in raw waste load and flow, and operational changes in the treatment system.

The daily variability factor, VF_1, is used to set daily maximum loading limits. It is calculated as the ratio of the 99th percentile of the data to the expected mean based on the distribution of the data.

The monthly variability factor, either VF_4 or VF_{30} (depending on whether 4 or 30 samples are collected during the month) is used to set monthly average loading limits. The monthly

variability factor is calculated as the ratio of the 95th percentile of the data to the expected mean based on the distribution of the data.

In order to determine whether variability factors were representative of normal plant operating conditions, extreme or outlier data values were reviewed. Loading variability factors, for the BAT plants, were calculated for each limited parameter with outliers included and outliers deleted (see Table 6.5). It was concluded that all of the data (outliers included) should be used for effluent limits setting because the data reflect the normal plant operations.

Step 5 The BAT Production-Based Loading Limits

The BAT production-based loading limit for each parameter is calculated as the product of the production-based LTA loading (g/tonne) and the appropriate variability factor. The daily maximum loading limit, which will be the basis for setting daily maximum limits, is calculated as the product of the BAT loading limit and the daily variability factor (VF_1). The monthly average loading limit, which will be the basis for setting monthly average limits, is calculated as a product of the BAT loading limit and the monthly variability factor (VF_4 or VF_{30}).

The calculated production-based loading limits (g/tonne) are presented in Table 6.6.

Ministry/Industry Review

Under the Metal Casting Sector Joint Technical Committee, a Limit Setting Subcommittee (LSS) was formed to review the BAT performance data and participate in the development of effluent loading limits. The Subcommittee consisted of representatives from the Industry, Environment Canada and the Ontario Ministry of the Environment and Energy.

The Subcommittee conducted a detailed review of the BAT consultant report recommendations, the BAT performance data and the existing Certificates of Approval and Control Orders. The Subcommittee's recommendations were considered in the development of effluent loading limits.

General Motors of Canada Ltd., St. Catharines

In February 1992 General Motors announced that its Foundry in St. Catharines will close by the fall of 1994. Consequently,

Table 6.5
BAT Loading Variability Factors

ATG	Parameter	General Motors				Haley Industries			
		Outliers Included		Outliers Deleted		Outliers Included		Outliers Deleted	
		VF_1	$VF_{30,4}$	VF_1	$VF_{30,4}$	VF_1	$VF_{30,4}$	VF_1	$VF_{30,4}$
2	Total Cyanide	2.30	1.38	2.29	1.38	5.04	1.98	4.50	1.86
4a	Ammonia plus Ammonium	3.38	1.61	3.38	1.61	2.81	1.55	2.93	1.54
4b	Nitrate plus Nitrite	2.18	1.34	2.18	1.34	-	-	-	-
5a	Dissolved Organic Carbon	3.20	1.56	3.17	1.57	-	-	-	-
6	Total Phosphorus	-	-	-	-	5.94	2.18	4.25	1.80
8	Total Suspended Solids	8.47	1.61	8.47	1.61	7.34	1.49	4.58	1.45
9	Aluminum	10.9	2.20	2.91	1.42	11.0	2.34	4.42	1.73
9	Chromium	-	-	-	-	9.68	2.15	4.49	1.70
9	Copper	-	-	-	-	7.13	1.93	4.65	1.75
9	Silver	-	-	-	-	5.21	1.94	5.46	1.88
9	Zinc	9.70	2.10	2.99	1.53	13.6	2.61	5.73	1.71
14	Phenolics (4AAP)	6.75	1.44	5.19	1.37	10.8	1.76	7.82	1.66

ATG = Analytical Test Group
VF_1 = Daily Variability Factor
VF_4 = Monthly Variability Factor based on the collection of four samples during a month for compliance monitoring
VF_{30} = Monthly Variability Factor based on the collection of thirty samples during a month for compliance monitoring

this plant was not considered further for effluent limits setting. Being the BAT plant, its performance data were used in calculating the limits for the limited parameters in the Wet Processes Category (i.e. for the Ford Motor Company of Canada plant).

Ford Motor Company of Canada Limited., Windsor Casting Plant, Windsor

During the LSS deliberations, Ford's representatives expressed concern about the production-based loading limits for total

Table 6.6
Production-Based Loading Limits (g/tonne)

ATG	Parameter	General Motors		Haley Industries	
		Daily Maximum	Monthly Average	Daily Maximum	Monthly Average
2	Total Cyanide	0.997	0.600	374	147
4a	Ammonia plus Ammonium	176	83.8	4890	2690
4b	Nitrate plus Nitrite	71.3	43.7	-	-
5a	Dissolved Organic Carbon	906	441	-	-
6	Total Phosphorus	-	-	770	282
8	Total Suspended Solids	12300	2330	115000	23300
9	Aluminum	535	108	1380	295
9	Chromium	-	-	463	103
9	Copper	-	-	240	64.6
9	Silver	-	-	111	41.2
9	Zinc	343	74.2	669	129
14	Phenolics (4AAP)	29.1	6.22	16.2	2.62

ATG = Analytical Test Group

cyanide, which happened to be the same as the Regulation Method Detection Limit (RMDL = 0.005 mg/L) for cyanide. They indicated that Ford may have difficulty in meeting the cyanide requirements. The LSS members noted that cyanide-based chemicals are not used in the process and that cyanide concentrations may differ between plants since cyanide is produced as a result of the high temperatures used during the metal melting process. Consequently, the LSS members agreed, that cyanide should be limited at Ford to the levels observed during the MISA effluent monitoring period.

The Ministry representatives of the LSS indicated that the zinc concentrations in the effluent from the General Motors plant (a BAT plant) did not reflect the levels achievable with BAT, since better performances were observed at similar plants. Therefore, a concentration value of 0.133 mg/L based on the performance

demonstrated at the Cleveland Casting Plant, Ford Motor Company, USA, was used to calculate the zinc loading limits for the Ford Motor Company of Canada, Windsor Casting Plant.

It should be noted that in addition to the effluent limits based on BAT #1, the Ford Motor Company of Canada has voluntarily submitted to the Ministry an abatement program consisting of the following main points:

- minimization or elimination of phenolics use by process improvements and/or process changes,
- replacement of wet air scrubbing systems with dry systems,
- the recycling of scrubber water from the higher efficiency wet scrubbers,
- work towards zero discharge or complete recycle systems.

Haley Industries Ltd., Haley

Since Haley Industries was identified as a BAT plant, the performance of its technology train was used as the basis for setting effluent limits. Although the technology train represents BAT, its performance during the MISA monitoring period was not optimized. After the end of the MISA monitoring period, Haley conducted an in-plant process optimization program as part of an overall effluent quality improvement program. This program included the following components:

- dust collector blowdowns were collected and treated with lime for metals and TSS removal
- effluent streams were segregated and pH adjustments were carried out to improve overall metal removal
- a carbon dioxide neutralization system was installed to make final pH adjustments after lime treatment
- a pressure sand filter was tested for the residual suspended solids removal in the treated, decanted process flows
- the total process flow was considered for treatment in a carbon column to remove trace concentrations of phenolics and several other organic compounds.

The production-based loading limits measured during the MISA monitoring period, the 6-months after the MISA monitoring period and the proposed Certificate of Approval values were reviewed

Table 6.7
Production-Based Loading Limits (g/tonne)
Haley Industries

ATG	Parameter	MISA Monitoring		Post MISA Monitoring		Proposed Certificate of Approval	
		Daily Maximum	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	Monthly Average
1a	Biochemical Oxygen Demand	-	-	62400	31700	3300	1340
2	Total Cyanide *	374	147	-	-	-	-
4a	Ammonia plus Ammonium	4890	2690	5830	3210	-	-
6	Total Phosphorus	770	282	315	115	-	-
8	Total Suspended Solids (TSS)	115000	23300	211000	42700	6640	1340
9	Aluminum	1380	295	1540	327	631	134
9	Chromium	463	103	351	77.7	242	53.7
9	Copper	240	64.6	256	69.0	199	53.7
9	Silver	111	41.2	107	39.7	145	53.7
9	Zinc	669	129	548	105	279	53.7
14	Phenolics (4AAP)	16.2	2.62	16.2	2.62	33.1	5.37

ATG = Analytical Test Group
* Total cyanide was not suspected to be a parameter of concern, therefore, it was not measured after MISA monitoring was completed.

and are shown in Table 6.7. The LSS recommended that the existing technology train should be able to perform at the levels representing the best of the three performances, and can be used as a basis for effluent limits setting.

Recommended Production-Based Loading Limits

The recommended production-based loading limits (g/tonne) for the Wet Processes and Haley Industries Categories are presented in Table 6.8.

Table 6.8
Recommended Production-Based
Loading Limits (g/tonne)

ATG	Parameter	General Motor		Haley Industries	
		Daily Maximum	Monthly Average	Daily Maximum	Monthly Average
1a	Biochemical Oxygen Demand	-	-	3300	1340
2	Total Cyanide	3.55	2.14	374	147
4a	Ammonia plus Ammonium	176	83.8	4890	2690
4b	Nitrate plus Nitrite	71.3	43.7	-	-
5a	Dissolved Organic Carbon	906	441	-	-
6	Total Phosphorus	-	-	315	115
8	Total Suspended Solids	12300	2330	6640	1340
9	Aluminum	535	108	631	134
9	Chromium	-	-	242	53.7
9	Copper	-	-	199	53.7
9	Silver	-	-	107	39.7
9	Zinc	116	25.2	279	53.7
14	Phenolics (4AAP)	29.1	6.22	16.2	2.62

ATG = Analytical Test Group

Step 6 The Plant - Specific Loading Limits

The plant-specific loading limit (kg/day) is calculated as the product of the recommended production-based BAT loading limit (g/tonne) and the plant reference production rate (tonnes/day). The plant reference production rate refers

Table 6.9
Effluent Loading Limits (kg/day)
Ford Motor Company of Canada, Windsor Casting Plant

ATG	Parameter	Daily Maximum Limit	Monthly Average Limit
2	Total Cyanide	4.19	2.52
4b	Nitrate plus Nitrite	84.1	51.5
5a	Dissolved Organic Carbon	1070	520
8	Total Suspended Solids	14500	2750
9	Aluminum	632	127
9	Zinc	137	29.7
14	Phenolics (4AAP)	34.4	7.35

REFERENCE PRODUCTION RATE = 1180 tonnes/day
ATG = Analytical Test Group

to the number of tonnes of metal melted per day, and it reflects the production rate corresponding to the design capacity of the plant.

The recommended daily maximum and the monthly average loading limits for the two limited plants are shown in Tables 6.9 and 6.10.

6.3 LOADING REDUCTIONS

The loading reductions (in kg/year and % reduced) calculated for each limited parameter and for each plant, are presented in Tables 6.11 and 6.12.

Table 6.10
Effluent Loading Limits (kg/day)
Haley Industries

ATG	Parameter	Daily Maximum Limit	Monthly Average Limit
1a	Biochemical Oxygen Demand	14.9	6.04
2	Total Cyanide	1.68	0.660
4a	Ammonia plus Ammonium	22.0	12.1
6	Total Phosphorus	1.42	0.519
8	Total Suspended Solids	29.9	6.04
9	Aluminum	2.84	0.604
9	Chromium	1.09	0.242
9	Copper	0.896	0.242
9	Silver	0.481	0.179
9	Zinc	1.26	0.242
14	Phenolics (4AAP)	0.0727	0.0118

REFERENCE PRODUCTION RATE = 4.5 tonnes/day
ATG = Analytical Test Group

6.4 COMPARISON WITH OTHER JURISDICTIONS

The United States

In the United States, Federal effluent guidelines have been developed for the Metal Molding and Casting Industry. Each plant that discharges to a surface water must apply to the Environmental Protection Agency (EPA) for a "National Pollutant Discharge Elimination System" (NPDES) permit. Each of the process segments was assigned an allowable mass loading in kg/tonne of metal poured and an allowed water use. Concentration-based limits are back-calculated from this information. The basis of the US EPA effluent limits development was different from that followed by Ontario, and therefore no comparison could be made.

Table 6.11
Loading Reductions
Ford Motor Company of Canada, Windsor Casting Plant

ATG	Parameter	MISA Loading (kg/year)	BAT Loading (kg/year)	Loading Reduction (kg/year)	Loading Reduction (%)
2	Total Cyanide	665	364	301	45.3
4b	Nitrate plus Nitrite	22300	7710	14600	65.5
5a	Dissolved Organic Carbon	94000	66700	27300	29.0
8	Total Suspended Solids	373000	342000	31000	8.31
9	Aluminum	23200	11600	11700	50.4
9	Zinc	26100	2830	23300	89.3
14	Phenolics (4AAP)	6430	1020	5410	84.1

Table 6.12
Loading Reductions
Haley Industries

ATG	Parameter	MISA Loading (kg/year)	The Preferred Option Loading (kg/year)	Loading Reduction (kg/year)	Loading Reduction (%)
1a	Biochemical Oxygen Demand	20300	814	19400	95.8
2	Total Cyanide	72.6	72.6	0	0
4a	Ammonia plus Ammonium	1700	1700	0	0
6	Total Phosphorus	127	51.8	74.8	58.9
8	Total Suspended Solids	15300	884	14400	94.1
9	Aluminum	123	56.2	67.2	54.6
9	Chromium	46.7	24.5	22.2	47.5
9	Copper	32.9	27.3	5.55	16.9
9	Silver	20.8	20.1	0.73	3.51
9	Zinc	48.2	20.1	28.1	58.4
14	Phenolics (4AAP)	1.46	1.46	0	0

Asia and Germany

In Japan, there is one set of regulations which covers the discharge of all industrial effluent and in Taiwan, there is a set of industrial regulations specific to the "metal

Table 6.13
Comparison of Concentration-Based Limits (mg/L)

ATG	Parameter	Other Jurisdiction			Ontario	
		Japan	Taiwan	Germany	Ford Motor Compeny Production 1180 t/d	Haley Industries Production 2.7 t/d
1a	Biochemical Oxygen Demand	120	-	-	-	25.0
2	Total Cyanide	1	1	-	0.02	2.7
8	Total Suspended Solids	150	200	-	25.9	25.0
9	Chromium	2	2	0.2	-	1.0
9	Copper	3	3	0.3	-	1.0
9	Silver	-	0.5	-	-	0.7
9	Zinc	5	5	-	0.3	1.0
14	Phenolics (4AAP)	5	-	-	0.07	0.05

ATG = Analytical Test Group

industries". Environmental discharge regulations in Germany are for industrial wastewater in general. The limits expressed in Table 6.13 provides an overview of limits which have been imposed on relevant parameters in Japan, Taiwan, Germany and the USA (one example). These limits for other jurisdictions apply to all industrial discharges, whether they are directed to a surface watercourse or to a municipal sewer. The German regulation also has mass and concentration-based limits where as the Japanese and Taiwanese limits are concentration based only.

6.5 REFERENCES

1. Beak Engineering Ltd. (October 1992). Best Available Technology for Effluent Treatment in the Metal Casting Sector. Brampton, Ontario. ISBN 0-778-0564-2

THE LIMITS REGULATION

CHAPTER 7

OF THE

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INTRODUCTION

These explanatory notes provide an expanded descriptions of each of the sections in the Effluent Monitoring and Effluent Limits Regulation - Metal Casting Sector.

The Regulation and its protocols specify the effluent monitoring requirements for each discharger including sampling, analysis, acute and chronic toxicity and conducting storm water control study.

This Regulation has nine parts:

Part I - deals with interpretation, purpose, application, by-passes and sampling and analytical procedures.

Part II - deals with establishment and elimination of sampling points.

Part III - deals with the calculation of loadings of process effluent and cooling water effluent.

Part IV - deals with the compliance with the loading limits and lethality limits.

Part V - deals with monitoring of process and cooling water effluent streams for chemical parameters and toxicity testing as well as quality control procedures for process effluent streams.

Part VI - deals with flow measurement and calculation of plant volume.

Part VII - deals with the storm water control study.

Part VIII - deals with the record keeping and reporting requirements.

Part IX - deals with the commencement and revocation provisions.

7.1 PART I - GENERAL

Section 1 - Interpretation

This section does not redefine terms which are already defined in the Environmental Protection Act under which the Metal Casting Sector Effluent Monitoring and Effluent Limits Regulation is written.

This section of the Regulation provides:

- clarification of terms used in the Regulation which may have several possible interpretations;
- definitions of the technical terms used in the Regulation which may not be in common usage;
- definitions of the terms used in the Regulation which may have meanings different than those found in a dictionary or through common usage;
- definitions of the terms used in the Regulation which are specific to the Metal Casting Sector.

Section 2 - Purpose

The purpose of the Limits Regulation is to monitor and control the quality of effluent that is discharged directly to surface watercourses by metal casting plants in Ontario.

Section 3 - Application

The Regulation applies to the seven direct-discharging metal casting plants in Ontario listed in Schedule 1 of the Regulation.

Section 4 - Obligations under Approvals, Order, etc.

This regulation neither limits nor reduces a discharger's obligations under approval, control order or any other Act.

Section 5 - Non-application of General Effluent Monitoring Regulation

The General Effluent Monitoring Regulation O. Reg. 695/88 will not apply to the Metal Casting Sector when this regulation is filed.

Section 6 - By-Passes

All process effluent must be discharged only through designated sampling points on the first day of the fourth year following the promulgation of this Regulation.

Section 7 - Sampling and Analytical Procedures

In order to ensure accurate sampling and analyses of effluent samples, standard sampling and analytical procedures have been developed by the Ministry. The Ministry protocol on sampling and analysis[1] outlines how a plant must collect a sample, how the sample should be analyzed, and the minimum analytical method detection level that the laboratory must meet when analyzing the sample.

Each plant must guarantee that all sampling equipment is maintained properly in order to ensure that a representative sample is always collected.

7.2 PART II - SAMPLING POINTS

Section 8 - Establishment and Elimination of Sampling Points

A plant must designate sampling points ninety days after the day this Regulation is filed, that allow representative samples to be collected for all process effluent and cooling water effluent streams. All samples collected for the Regulation must be taken from designated sampling points so that the plant loadings will accurately reflect the level of discharge of each limited parameter and assessment parameter from the plant.

Section 9 - Reports on Sampling points

Within hundred days after the day this Regulation is filed, the discharger shall submit to the Director a list and plot

plan showing the sampling points established under this Regulation.

Within thirty days of establishing a new sampling point or eliminating an old sampling point, the discharger shall inform the Director about the changes.

Section 10 - Use of Sampling points Established Under This Part

Sampling points established under this Regulation must be used for all sampling requirements of this Regulation.

7.3 PART III - CALCULATION OF LOADINGS

Section 11 - Calculation of Loadings - General

The actual analytical result must be used when calculating parameter loadings if the actual analytical result is greater than 1/10th of the analytical method detection limit listed in the Ministry protocol on sampling and analysis[1]. Otherwise, the value of zero must be used.

Section 12 - Calculation of Loadings - Process Effluent

In order to determine compliance with the daily plant loading limits, a daily process effluent stream loading for each limited parameter must first be calculated. This is done by multiplying the analytical result of the monitored parameter by the daily volume of the effluent. Then, a daily process effluent plant loading of the monitored parameter is calculated as a sum of the daily process effluent stream loadings of the monitored parameter.

In order to determine compliance with the monthly average plant loading limits, a monthly average plant loading for each limited parameter must be calculated. This is done by taking the arithmetic mean of the daily process effluent plant loadings of the limited parameter reported for the month.

Section 13 - Calculation of Loadings - Cooling Water

Each plant listed in Schedule 3 is required to calculate the daily cooling water effluent plant loading and monthly average

cooling water effluent plant loading for reporting to the Director.

7.4 PART IV - PARAMETER AND LETHALITY LIMITS

Section 14 - Parameter Limits

If the calculated daily process effluent plant loading of the limited parameter exceeds the daily plant loading limit for that parameter, then the plant is considered to be out of compliance with the requirements of the Regulation.

If the calculated monthly average process effluent plant loading of the limited parameter exceeds the monthly average plant loading limit for that parameter, then the plant is considered to be out of compliance with the requirements of the Regulation.

Each discharged will control the quality of each process effluent monitoring stream by making sure that the pH range of the effluent at each process effluent monitoring sampling point or at an alternate sampling point is within the range of 6.0 to 9.5.

Section 15 - Lethality Limits

Rainbow Trout and Daphnia magna acute lethality tests carried out by the discharger at each process effluent and cooling water effluent shall not result in mortality for no more than 50 % of the test organisms in one hundred percent effluent.

7.5 PART V - MONITORING

Section 16 - Monitoring - General

On a day when there is no process effluent discharged, no samples will be collected.

The Regulation allows the discharger to pick up all the samples within a period of three hours. The samples should be analyzed and the results made available to the discharger as soon as possible.

Sections 17 & 18 - Monitoring - Process Effluent - Daily and Weekly

Each process effluent discharger is required to collect and analyze effluent samples for the parameters for which the frequency of monitoring is indicated in Column 2 of Schedule 2 as being daily or weekly. The frequency of monitoring for each limited parameter is shown in Table 7.1.

Table 7.1
Monitoring Frequency for
Limited Parameters

Parameter	Frequency
Total Cyanide	Weekly
pH	Daily
Ammonia plus Ammonium	Weekly
Nitrate plus Nitrite	Weekly
Dissolved Organic Carbon	Daily
Total Phosphorus	Weekly
Total Suspended Solids	Daily
Aluminum	Weekly
Chromium	Weekly
Copper	Weekly
Silver	Weekly
Zinc	Weekly
Phenolics (4AAP)	Daily
Biochemical Oxygen Demand	Weekly

Section 19 - Monitoring - Process Effluent - Quality Control

Each process effluent discharger must collect once per year from one process effluent sampling point a set of quality control samples for those parameters listed in schedule 2 under weekly monitoring. The set of quality control samples must include:

- a duplicate or replicate sample,
- a travelling blank sample, and
- a travelling spiked blank sample.

The samples for quality control monitoring must be collected on the same day as the regular compliance monitoring samples for the limited parameters. Procedures for collecting these quality control samples are outlined in the Ministry of the Environment "Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater[1]".

Section 20 - Monitoring - Process Effluent - pH Measurement

Plants must collect from the sampling point established under this Regulation three grab samples and analyze each sample for the parameter pH or install an on-line pH analyzers on each stream for continuous pH monitoring over 24 hour period.

Sections 21 & 22 - Monitoring - Acute Lethality Testing - Rainbow Trout and Daphnia magna

The Environment Canada protocols on acute lethality testing[2,3] describe the sampling and analytical procedures that have to be followed when conducting the acute lethality tests.

If a plant passes twelve consecutive acute lethality tests for Rainbow Trout, then the plant is allowed to monitor acute lethality tests on a quarterly basis. In the event that an acute lethality test for Rainbow Trout resulted in a mortality of more than fifty percent, monthly acute lethality test of the effluent will be resumed.

The same conditions of testing frequency apply to the acute lethality tests for Daphnia magna.

Section 23 - Monitoring - Chronic Toxicity Testing - Fathead Minnow and Ceriodaphnia dubia

When a plant passes twelve consecutive Rainbow Trout and Daphnia magna acute lethality tests, the discharger is required to monitor chronic toxicity to Ceriodaphnia dubia and fathead minnow once every six months. These 7-day tests study Ceriodaphnia dubia reproduction inhibition and survival and fathead minnow growth inhibition are only required to be carried out at each process effluent stream. The Environment Canada protocols on chronic toxicity testing[4,5] describe the sampling and analytical procedures that have to be followed when conducting the chronic toxicity tests.

Section 24 - Cooling Water Effluent - Weekly Assessment

Cooling water effluent has to be monitored once per week for assessment purposes according to Schedule 3 of the Regulation. Table 7.2 lists the parameters that have to be monitored.

Table 7.2
Cooling Water Effluent Assessment Monitoring Parameters

Analytical Test Group	Parameter
5a	Dissolved Organic Carbon
8	Total Suspended Solids
14	Phenolics (4AAP)
30	Fluoride

7.6 PART VI - EFFLUENT VOLUME

Section 25 - Flow Measurement

In order to determine daily and monthly average plant loadings, each plant must measure the daily flow of all

process effluent streams for each day on which a sample is collected. Each flow measurement device must:

- be installed and maintained properly to meet the accuracy requirements of ±15% set by this Regulation,
- be easily accessible for inspection by a provincial officer, and

Each plant with cooling water effluent must also measure the flow of cooling water on the day that samples are collected. Each flow measurement device must:

- be maintained in the same manner as the process effluent flow measurement devices; and,
- be accurate to within ±20%.

Section 26 - Calculation of Plant Volumes

A plant must calculate the daily plant volumes of process effluent that is discharged for each day. Daily plant volume is the sum of the daily process effluent volumes of all process effluent streams that are discharged. The plant must also calculate the daily plant volume of cooling water effluent that is discharged on the days that cooling water effluent samples are collected.

A plant must calculate the monthly average process effluent plant volume and monthly average cooling water effluent plant volume. Monthly average plant volume is calculated as the arithmetic mean of the daily plant volumes calculated for the month.

7.7 PART VII - STORM WATER CONTROL STUDY

Section 27 - Storm Water Control Study

Each plant must complete a storm water control study (SWCS) in accordance with the guidelines set in the storm water control study protocol published by the Ministry of the Environment and Energy[6]. The protocol outlines:

- The role and responsibilities of the discharger
- The exemption criteria that determine whether or not a study is required

- The requirements that must be followed in conducting a study and developing a control program

Findings of the study and the details of the storm water control project(s) will be documented in a Storm Water Monitoring Report (SWMR). A copy of each completed SWMR will be kept at the plant and made available to Ministry staff upon request.

7.8 PART VIII - RECORDS AND REPORTS

Section 28 - Record Keeping

The discharger must keep records in electronic format of all analytical results and calculations performed to determine loadings and volumes for each process effluent and cooling water effluent stream. The discharger must keep records of all the sampling and analytical procedures, the maintenance and calibration procedures and the monitoring results of the acute lethality and chronic toxicity testing.

The discharger must also keep records of all malfunctions related to effluent sampling, chemical analysis, toxicity testing, and flow measurement or other problems that interfere with meeting the requirements of the Regulation. Records must be kept by the discharger of all process changes and redirections and of any occurrence of a by-pass stating date, duration and cause. A record of the daily production (tonnes) must be kept by the discharger.

All records required by this regulation must be kept on file for three years and be available to Ministry staff upon request.

Section 29 - Reports Available to the Public

Each discharger must prepare an annual report and make it available to the public at the discharger's plant. The report will include:

- All non-compliance events in regard to parameter limits and lethality limits.
- An annual summary of all monitoring results of the chronic toxicity and the acute lethality testing.

- An annual summary of plant loadings and plant volumes for process effluent and cooling water effluent.

Sections 30, 31,32 &33 - Reports to the Director

Each discharger shall notify the Director in writing within thirty days of the change or redirection:

- Of any change of name or ownership of the discharger's plant and of any process change or redirection of effluent stream that affects the quality of effluent at any established sampling point

- If the plant has operated for more than 90 consecutive days at less than 75% of the reference production rate.

Each discharger shall report to the Director orally and in writing as soon as possible of any occurrence of a by-pass or any non-compliance with loading and lethality limits.

Each discharger shall submit a quarterly report both in electronic format and hard copy within 45 days after the end of each quarter:

- Incidents of non-compliance with loading and lethality limits

- The monthly average plant loadings and the highest and lowest daily plant loadings for process effluent and cooling water effluent.

- The monthly average plant volumes and the highest and lowest daily plant volumes for process effluent and cooling water effluent.

- For each month, the highest and lowest pH results for each process effluent stream.

A summary of all chronic toxicity test results within 60 days after the end of the semi-annual period in which the samples were collected.

7.9 PART IX - COMMENCEMENT AND REVOCATION PROVISIONS

Section 34

The Metal Casting Sector Effluent Monitoring Regulation O. Reg. 648/89 is revoked after 90 days after the day on which this Regulation is filed.

Section 35

Part IV of this Regulation comes into force the first day of the fourth year after the day on which this Regulation is filed.

Part V and VI of this regulation come into force 90 days after the day on which this Regulation is filed.

7.10 REFERENCES

1. Ontario Ministry of the Environment (1991). Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater. Toronto, Ontario.

2. Environment Canada (1990). Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout. Toronto, Ontario.

3. Environment Canada (1990). Reference Method for Determining Acute Lethality of Effluents to Daphnia magna". Toronto, Ontario.

4. Environment Canada (1992). Test of Reproduction and Survival Using the Cladoceran Ceriodaphnia dubia. Toronto, Ontario.

5. Environment Canada (1992). Test of Larval Growth and Survival Using Fathead Minnows. Toronto, Ontario.

6. Ministry of the Environment (1992). MISA Protocol For Conducting A Storm Water Control Study. Toronto, Ontario.

INDUSTRY ECONOMIC PROFILE

APPENDIX A

OF THE

DEVELOPMENT DOCUMENT

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A.1 INDUSTRY PROFILE

The economic dimensions of the metal casting industry in Ontario and Canada and the product markets they serve are reviewed in this section. This review will include an assessment of the importance of the industry to the national and provincial economies, identification of product markets and an examination of historical trends and the future outlook for these markets.

A.2 INDUSTRY OVERVIEW

The Metal Casting Sector consists of manufacturers of metal objects produced by cooling molten metal into desired shapes. The wide range of finished products produced by the Metal Casting Sector are made from different metals and molding techniques.

Manufacturers require cast metal shapes in order to produce durable goods. They can either buy castings from companies that specialize in the technology, or they can produce their own castings as part of their production process. From an economic point of view, there are basically two types of foundries: captive and jobbing. For captive producers, metal casting is part of a vertically integrated process to produce end products. For example, the automotive casting plants would be considered captive producers because they cast parts solely for specific models of automobiles. Jobbing producers specialize in supplying castings for any number of market sectors. For example, Haley Industries supplies parts to a number of aircraft engine manufacturers and air frame doors directly to Boeing.

Metal casting is actively undertaken by manufacturers throughout the world. Table A.1 indicates the distribution of metal casting production around the world. Note that the former Soviet Union is the largest producer of castings while Canada ranked 16 in terms of metric tonnes of castings in 1990.

The Canadian Metal Casting Sector consisted of 275 metal casting plants employing in excess of 15,000 people in 1991.[a] Ontario is the leading metal casting province with

[a] Foundry Management & Technology, May 1992 and The Canadian Foundry Association, September 9, 1992.

TABLE A.1
WORLD CASTING PRODUCTION IN 1990

Country	1990 Total (in metric tonnes)
1. USSR	18,000,000
2. United States	10,210,512
3. China, People's Rep.	8,859,400
4. Japan	6,804,601
5. Germany	4,249,617
6. France	2,380,764
7. Italy	1,913,900
8. Czechoslovakia	1,432,822
9. United Kingdom	1,421,700
10. Korea Rep.	1,395,200
11. Poland	1,258,500
12. Romania	1,016,341
13. China, Taiwan	935,000
14. Spain	908,500
15. Mexico, D.F.	846,963
16. Canada	**668,680**
17. Turkey	575,000
18. Sweden	307,400
19. Austria	251,685
20. South Africa	216,401
21. Switzerland	182,950
22. Hungary	173,136
23. Netherlands	148,400
24. Finland	128,496
25. Denmark	122,213
26. Portugal	110,585
27. Peru	71,300
28. Norway	60,825
29. Israel	24,240
30. Zambia	17,743
Total:	64,692,874
Source: Modern Casting, Dec. 1991. pg. 25.	

approximately 159 foundries active in 1991, of which 137 were jobbing foundries and 22 were captive foundries. Ontario represented more than half or 58% of the country's total metal casting plants.[b]

In Ontario, it is estimated that about 10,000 people are employed in the metal casting industry. This represents about two thirds of total employment in the canadian metal casting industry.[c] Furthermore, the number of people employed in the Metal Casting Sector represents about 0.2% of the total Ontario workforce and about 1.0% of manufacturing employment. The number of Ontario foundries by employment size is shown in Table A.2.

Ontario Metal Casting Plants Subject to MISA Regulations

In Ontario, there are eight metal casting plants that directly discharge their wastewater into streams or lakes. These plants were subject to MISA Monitoring Regulations in 1990. Table A.3 provides a brief description of the location, corporate ownership, and employment of these metal casting plants. A ninth and tenth plant were included in the monitoring phase of MISA but have since been exempt from the limit phase of MISA. Canada Pipe installed a recycling system that allowed it to attain a zero discharge of effluent. Franklin Electric Co. closed the manufacturing segment of its Strathroy operations and moved to the United States.

Castings vary widely in size, alloy composition, complexity of shape and tolerance. The Metal Casting Sector manufactures a variety of products ranging from sophisticated aerospace components to drawer handles which can be divided between ferrous and non-ferrous goods. In the ferrous category, these products are made from steel, malleable iron, ductile iron and gray iron. In the non-ferrous category, products are made from aluminum, copper, magnesium, zinc and their associated alloys. As shown in Table A.4, aluminum is the principal metal cast in Ontario with 82 plants manufacturing aluminum castings. Gray Iron foundries were the second largest with 51 foundries.

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[b] Foundry Management & Technology, January 1992, pg. 31.

[c] Foundry Management 1992 Metal Casting Industry Census Guide.

TABLE A.2
ONTARIO FOUNDRIES BY SIZE

Size of Foundries	Number of Foundries
1,000 or more employees	2
500 to 999 employees	1
250 to 499 employees	9
100 to 249 employees	25
50 to 99 employees	28
20 to 49 employees	40
Under 20 employees	54
TOTAL:	159
Source: Foundry Management and Technology, May 1992. pg. 38.	

There are at least 30 different product market segments for metal casting. Some of the more notable products include automotive engine and transmission parts, industrial machinery and equipment, construction materials, railway parts, agricultural equipment, electrical components and tools. The estimated consumption of metal castings in Ontario by sector is shown in Table A.5.

Since most castings are intermediate goods used in the construction of a larger final good, the financial performance of a metal casting producer depends to a large extent on the market sector it sells its products to. Furthermore, the Metal Casting Sector is very sensitive to business cycle fluctuations, with sales closely tied to the demand of automotive, construction and consumer products sectors. In other words, if demand in the market sector drops, there will be reduced demand for castings, causing lower prices and lower casting production. For example, the demand for automobiles determines the demand for castings from the three largest casting producers in Ontario. If consumers forego the purchase of a new car, there will be fewer castings produced

TABLE A.3
METAL CASTING SECTOR PLANTS

Plant	Location	Corporate Ownership	Employment (1990)
Canada Alloy Castings, Ltd.	Kitchener	Provincial Incorporation 03.12.56 Multiple Shareholders	210
Chrysler Canada Inc.	Etobicoke	Chrysler Canada Inc.	450
Ford Motor Company, Windsor Casting Plant	Windsor	Ford Motor Company of Canada Ltd.	1,000
General Motors	St. Catharines	General Motor of Canada Limited	2,500
Haley Industries	Haley	Haley Industries Ltd.	413
Kubota Metal Corporation, Fahramet Division	Orillia	Kubota Corporation, Japan	240
Meridian Richmond Die Casting Ltd.	Cornwall	Meridian Technologies Company	110*
Western Foundry Company Limited	Wingham	Richard Levan Investment Ltd. and 1.F.T. Investment Ltd.	200-250*
Total			5,173

SOURCE:VHB Research and Consulting Inc., Water Pollution Abatement Technology Cost Study, January 20, 1991.

* MOE, MISA Actual Monitoring Cost Questionnaire, 1990.

and lower profitability for metal casting producers.

Historical Trends

To quantify volume of output for the industry as a whole, metric tonnes of castings can be used. It should be noted that volume is not directly related to value of castings. For example, a large roughly finished casting may cost much less to produce than a small smoothly finished casting manufactured to extremely close tolerances.

TABLE A.4
Type of Metal Casting Plants in Ontario

Metal Cast Type	Number of Ontario Foundries
Aluminum	82
Gray Iron	51
Brass or Bronze	46
Ductile Iron	34
Zinc	24
Steel	20
Magnesium	7
Malleable Iron	4
Source: Foundry Management and Technology, May 1992. pg. 38.	

Statistics Canada prepares statistics on metal casting shipments. These statistics are not complete in absolute terms because they do not include all metal casting producers and products and do not include metal castings shipped but reported under durable goods classification. Unfortunately alternative sources of data do not exist. Nonetheless, statistics obtained from Statistics Canada provide the reader

TABLE A.5
ONTARIO MARKET SECTOR FOR METAL CASTING

Market Type	% Estimated Share of Ontario Consumption of Castings
Automotive (car and truck parts)	55
Agricultural Equipment	3
Municipal and Construction	10
Resource Industry equipment	5
Aircraft	5
Valves, pumps and pipes	3
Machinery and Equipment, including electrical	10
Other transportation equipment	5
Other	4
Source: Deloittee, Haskins & Sells, April 1988, pg 59.	

with an historical perspective of the industry over the last ten years.

Figure A.1 presents the volume of steel castings and the value of shipments in the iron foundries sector from 1982 to 1991. The value of iron foundries shipments peaked in 1988 at $948,000. Following 1988, the value of iron foundries shipments declined at an average annual rate of -12.6%. The volume of steel casting shipments also peaked in 1988 at 130,074 metric tonnes. The average annual rate of growth in steel casting shipments since 1988 was also negative at -12.5%.

Volumes of U.S. metal casting shipments for the years 1982 to 1991 are presented in Tables A.6 and A.7 and average annual rate of growth for the two countries are summarized in Table A.8. Note in particular the difference in growth of steel

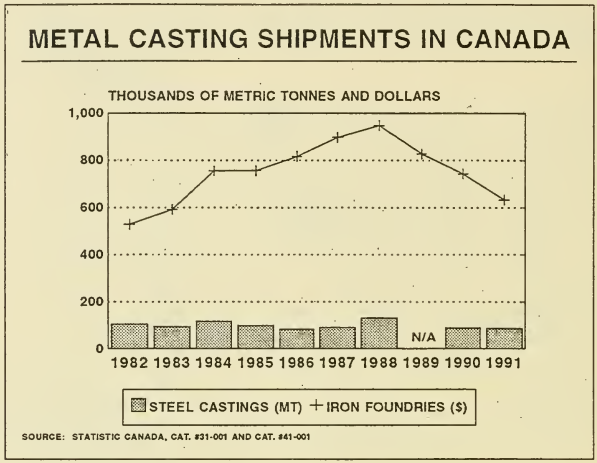

Figure A.1

castings between the two countries.

To determine whether the industry has kept pace with the growth in durable goods manufactured in Canada between 1982 and 1991, statistics on the value of shipments of selected durable goods in constant dollars are presented in Figure A.2 and Figure A.3. An analysis of durable goods is important since complete data is unavailable for metal castings, and as stated previously, many castings are not accounted for because they are components of durable goods. It is likely then that the demand for castings may be influenced by the degree of activity in the end-use sectors. As well, it is important to

TABLE A.6
VOLUME OF U.S. IRON AND STEEL CASTINGS
(thousands of tonnes per year)

Year	Iron Castings	Steel Castings	Total Ferrous
1980	11,110	1,703	12,813
1981	N/A	N/A	N/A
1982	7,709	922	8,631
1983	8,651	661	9,312
1984	9,886	853	10,739
1985	8,233	852	9,085
1986	8,109	749	8,858
1987	8,223	919	9,142
1988	8,593	1,077	9,670
1989	8,397	1,074	9,471
1990	7,754	1,028	8,782
1991	6,744	908	7,651

SOURCE:
Statistical Abstract of the United States 11th ed., 1991, pg. 758 (for 1980 to 1986 figures).

U.S. Department of Commerce, Bureau of Census, Industry Division, Current Industrial Reports, Iron and Steel Castings, MA33A(91)-1.

note whether or not the trend is the same for both durable goods and casting data. A comparison of the rates of growth of both durable goods and castings will indicate whether or not the trend in castings per durable goods produced has increased or decreased over time. Average annual rate of growth in shipments in durable goods are summarized in Table A.9.

TABLE A.7
VOLUME OF U.S. NON-FERROUS CASTINGS
(thousands of tonnes per year)

Year	Aluminum Castings	Copper-base Castings	Zinc-base Castings	Magnesium Castings	Lead-base Castings	Total Non-ferrous
1980	766	260	220	11	21	1,279
1981	825	256	214	10	17	1,323
1982	728	201	184	8	17	1,138
1983	861	226	222	12	25	1,346
1984	1,013	229	247	12	23	1,524
1985	1,011	213	232	11	21	1,488
1986	1,000	216	220	10	22	1,469
1987	1,007	217	223	10	21	1,479
1988	1,051	227	221	11	23	1,533
1989	995	215	209	11	21	1,452
1990	929	191	188	12	22	1,342
1991	864	183	172	11	17	1,247

Source: Statistical Abstract of the United States 11th ed., 1991, pg. 758. (for 1980 to 1986 figures). U.S. Department of Commerce, Bureau of Census, Industry Division, Current Industrial Reports, for Nonferrous Castings MA33E(91)-1.

Total durable goods have experienced a positive average annual growth rate of 1.3% from 1988 to 1991. During this same period, industrial machinery, cars and trucks, and aircraft and related parts also had a positive average annual, 1986 constant dollar growth rate of 0.7%, 7.8% and 13.4% respectively. More recently, from 1990 to 1991 the value of shipments of aircraft and related parts, and industrial machinery decreased by $229 million and $1,209 million (1986 constant dollars) respectively. Since 1990, this represents an 4.6% drop for the aircraft industry and an 15.2% decline

TABLE A.8
AVERAGE ANNUAL RATE OF NOMINAL GROWTH IN SHIPMENTS

1982 to 1991	Iron foundries	Iron	Steel	Aluminum	Copper-based	Zinc	Magnesium	Lead
Canada (value)	2.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Canada (volume)	N/A	N/A	-2.0%	N/A	N/A	N/A	N/A	N/A
U.S.A. (volume)	N/A	-1.0%	1.3%	2.3%	-0.9%	-0.3%	4.6%	1.7%

N/A = Not Available

Source: Summarized from data presented in Table A.6, Table A.7 and Figure A.1.

for the industrial machinery industry.

Growth rates in Tables A.8 and A.9 seem to indicate that metal casting shipments have not kept up with durable goods shipments. Even during the boom of the mid and late 1980's, the industry did not experience growth similar to its end products. This may suggest that the metal casting industry is in decline since castings are components of durable goods.

To further support this view, U.S. data for the value of ferrous and non-ferrous shipments in both nominal and real dollars is presented in Table A.10. The rate of real decline in the U.S. shipments per year is 0.05 per cent in ferrous castings and 0.01 per cent in non-ferrous castings.

Possible reasons for the decline of the metal casting industry in North America include the following:

- Increase use of substitute materials such as plastics, ceramics and powdered metals.
- Manufacturers move to smaller and lighter end products, therefore reducing the total volume of their end products.
- New and improved technologies for producing metal parts.

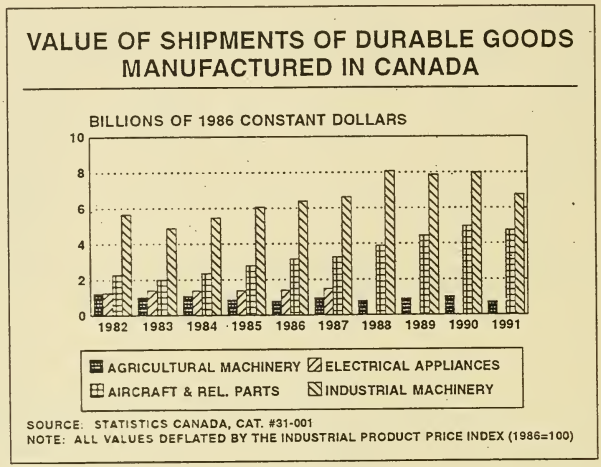

Figure A.2

- Demise of traditional industries such as ship building and railway stock rolling.
- Increase in manufactured imports into Canadian economy.

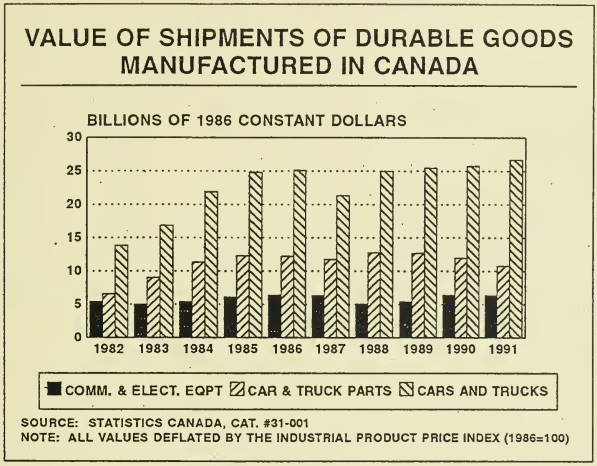

Figure A.3

A.3 INTERNATIONAL TRADE

Trends in imports and exports for basic metal castings and for manufactured durable goods that contain cast metal parts are presented in this section.

International trade is a key factor in the Canadian metal casting industry. Export potential provides opportunities for marginal revenue for the industry as it attempts to use excess

TABLE A.9
TRENDS IN CANADIAN SHIPMENTS OF DURABLE GOODS

	Average Annual Constant Growth Rate in Value of Shipments (%)	
	1982 - 1987	1988 - 1991
Industrial machinery	3.2	0.7
Agricultural machinery	-5.2	-9.3
Cars and trucks	9.0	7.8
Car and truck parts	12.3	-2.8
Aircraft and related parts	7.5	13.4
Electrical appliances	3.4	----
Communications and other industrial electronics equipment	3.0	0
Total durable goods	6.0	1.3

Source: Statistics Canada, 1991.

capacity. Import threats provide strong competitive pressures for the industry as it struggles to maintain profitability.

Few statistics are available to indicate what proportion of domestic metal casting production is exported, or what portion of metal casting consumption is imported. As stated previously, demand for metal castings is driven by the demand for durable goods. Since Canada is a major importer and exporter of durable goods, international trade has a significant impact on the Ontario metal casting industry.

TABLE A.10
VALUE OF U.S. METAL CASTING SHIPMENTS

	Nominal dollars			1982 Real dollars		
Year	Ferrous	Non-ferrous	Total	Ferrous	Non-ferrous	Total
1977	10,830	3,826	14,656	15,926	5,138	21,064
1978	12,503	4,296	16,766	17,086	5,600	22,686
1979	13,657	5,182	18,839	17,015	5,909	22,924
1980	12,637	5,084	17,721	14,247	5,181	19,428
1981	12,947	5,256	18,203	13,613	5,285	18,898
1982	9,641	4,603	14,244	9,641	4,603	14,244
1983	9,280	5,172	14,452	9,056	5,087	14,143
1984	11,315	6,258	17,573	10,717	5,812	16,529
1985	10,610	6,130	16,740	9,775	5,708	15,483
1986	10,320	6,172	16,492	9,230	5,611	14,841
1987	10,830	6,233	17,063	9,400	5,516	14,916
1988	11,395	6,526	17,921	9,600	5,626	15,226
1989	9,249	4,928	14,177	7,435	4,054	11,489
1990	9,117	4,610	13,727	6,954	3,598	10,552
1991	8,324	4,215	12,539	6,093	3,157	9,250
AVERAGE ANNUAL RATE OF GROWTH (1977 TO 1991)						
	0	0.03	0.01	-0.05	-0.01	-0.04

Source: U.S. Industrial Outlook 1988.pg. 20-7 and 21-22.

Imports and Exports of Basic Metal Castings

In terms of export and import data from Statistics Canada, it is important to note that all data up to and including 1987 cannot be compared with data from 1988 onwards. Starting in 1988, Statistic Canada changed their method of collecting this data from a Canadian International Trade Classification System to a Harmonized System. The two are not comparable because the Harmonized System is an International coding system which is different than the coding system used in the Trade Classification System.

Refer to Figure A.4 to Figure A.8, for Canadian exports and imports of iron, steel and aluminum castings for 1982 to 1991. With the exception of 1988 and 1989, the volume of iron

castings exports have greatly exceeded imports throughout the ten year period. Prior to 1988, the value of Canadian iron casting exports have been significantly larger than the value of imports. Starting in 1988, the value of iron casting imports have been slightly larger than exports. It is not clear whether this is a result of the change in the way the data is collected or a real change in the trade balance. In both 1990 and 1991, iron casting exports accounted for about 9% of the total value of iron foundries shipments. This may be an underestimate of the size of the export component because this does not include castings shipped as components of finished products.

Between 1982 to 1991, the quantity of steel casting exports has significantly exceeded imports with the exception of 1988. Concerning the value of steel castings, imports were slightly greater than exports in 1988 only. In 1990 and 1991, exports of steel castings accounted for about 81% and 57% of steel casting shipments by volume respectively.

The value of Canadian aluminum casting imports exceeded exports starting in 1988. Again, it is not clear whether this is a result of the change in the way the data is collected or a real change in the trade balance. The value of aluminum castings imports and exports has been declining since 1988.

Imports and Exports of Durable Goods

The value, in constant 1986 dollars, of Imports and Exports of manufactured durable goods that contain cast metal parts are presented in Figure A.9 to Figure A.12.

Throughout the ten year period, from 1982 to 1991, the value of Canadian imports of industrial machinery have greatly exceeded exports. Similarly, the value of Canadian imports of car and truck parts were greater than exports during this period. In contrast, the value of Canadian imports of cars and trucks was lower than exports from 1982 to 1991. The value of exports of aircraft parts was similar to imports from 1982 to 1989, while in 1990 and 1991 imports exceeded exports.

Average annual rates of growth in 1986 constant dollars of durable goods imported and exported are shown by major commodity group in Table A.11. Overall, the average annual rate of growth in imports of durable goods exceeds that of exports.

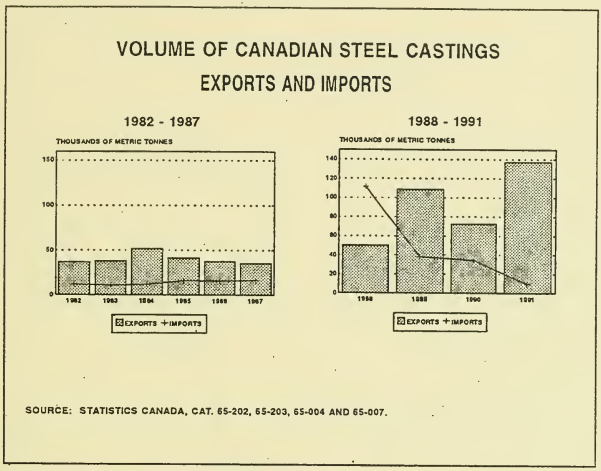

Figure A.4

In conclusion, the rate of growth in imports of metal castings and durable goods is exceeding that of exports. It appears that competition from imports is growing and may pose a threat to the domestic metal casting industry.

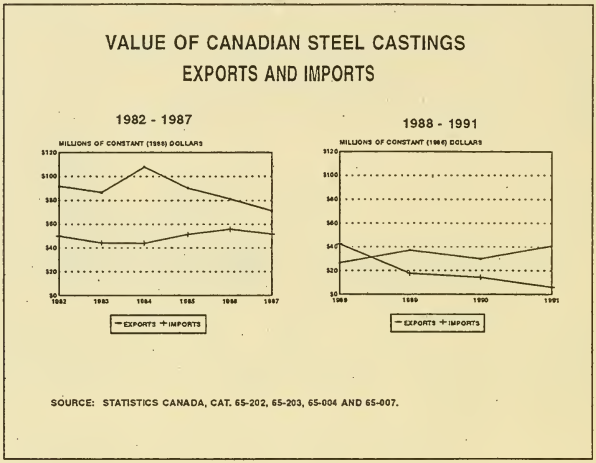

Figure A.5

A.4 MARKET OUTLOOK[d]

Canadian Outlook

Since the start of the recession in 1990, economic output has fallen nearly 2% and employment has decreased by approximately 360,000 in Canada. Interest rates continue to decline. In 1991, the Canadian economy shrank approximately 1.1% in terms

[d] This section is taken largely from the Canadian Imperial Bank of Commerce, Economics Division, Summer 1992.

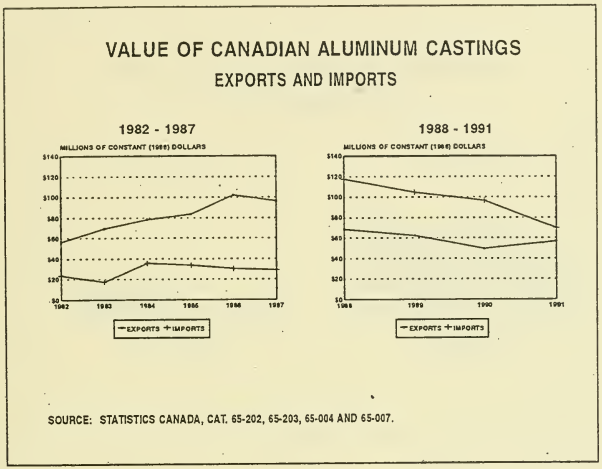

Figure A.6

of real Gross Domestic Product. GDP is likely to rise by about 2% in 1992, and a further 3% in 1993. Both business and consumer confidence remain low. The sharp decline in personal income in real terms over the last two years, in addition to a persistent weakness in labour demand has lead to a lagging in consumer spending. The purchasing power of consumers has been eroded by heavy employment losses. In 1991, real disposable income fell by 2.3%. Disposable income is expected to further decline by 1.8% in 1992. In late 1992 and throughout 1993, disposable incomes are expected to rebound due to stronger employment growth and stable inflation. In summary, consumer spending is likely to be unchanged from its

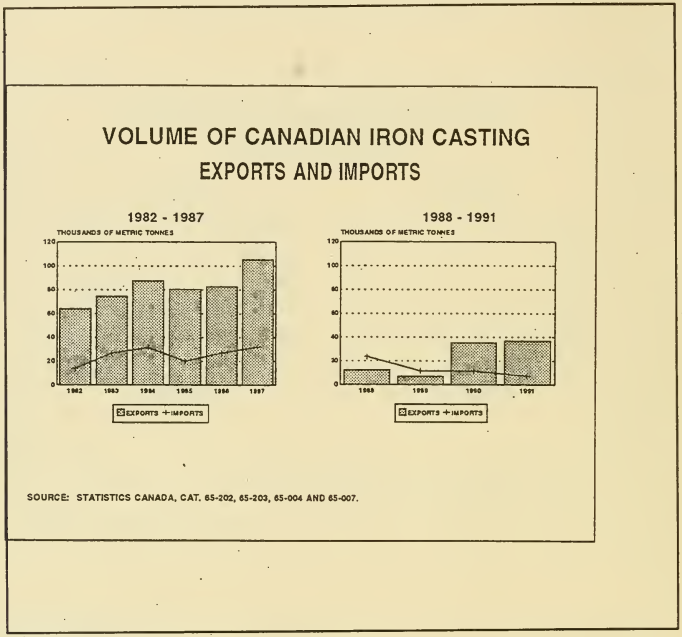

Figure A.7

1991 level in 1992, but is expected to rise by 3.4% this year.

In terms of business investment, machinery and equipment spending is expected to grow by 8% this year and 10% next year.

Canada's current inflation, at under two percent, is the lowest it has been since the early 1970's.[c]

[c] Canadian Imperial Bank of Commerce, Economics Division, Summer 1992. pg. 14 & 15.

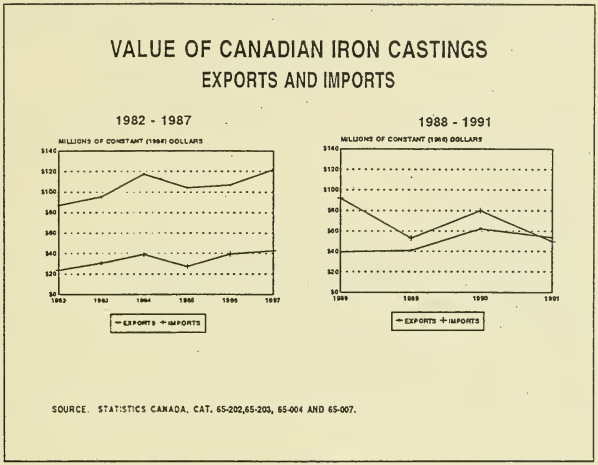

Figure A.8

Ontario Outlook

The Ontario economy was the hardest hit by the recession. The recovery is expected to be much more sluggish than the 1981-2 recession. This has implications for the consumer spending. The rise in interest rates and debt loads have lead to a curtailment in household spending in mid 1989. Since then, job loss has further depressed consumers attitudes. Stronger growth is expected in 1993. With the stronger growth projected for the U.S., Ontario's exports could be the key engine of growth for the provincial economy. Most business

TABLE A.11
TRENDS IN DURABLE GOODS IMPORTS AND EXPORTS

	1988 to 1991 Average Annual Rate of Growth in Value	
	% of imports	% of exports
Industrial Machinery	-4.2%	6.2%
Agricultural Machinery	-9.1%	-6.2%
Cars and Trucks	-5.5%	-4.7%
Car and Truck Parts	-7.8%	-5.2%
Aircraft and Related Parts	-5.6%	17.6%
Source: Statistics Canada, 1991.		

investment will be in machinery and equipment.[f]

U.S. Outlook

In 1992, a moderate growth in U.S. GNP and renewed consumer confidence in the U.S. economy is expected to increase retail sales of U.S. made passenger cars and trucks. The U.S. trade deficit in automotive parts is expected to further decline in 1992. Imports should return to their pre-recession growth rates, which were higher than those of exports during the 1980's. Parts shipments from Canada, Mexico, the European Community, and Japan should increase as G.M., Ford and Chrysler, and U.S. based Japanese vehicle makers respond to rising U.S. vehicle sales. This should help the Ontario metal casting industry since Ontario accounts for a large proportion of Canadian autopart manufacturing. More than half of U.S.

[f] Canadian Imperial Bank of Commerce, Economics Division, Summer 1992. pg. 36 and 37.

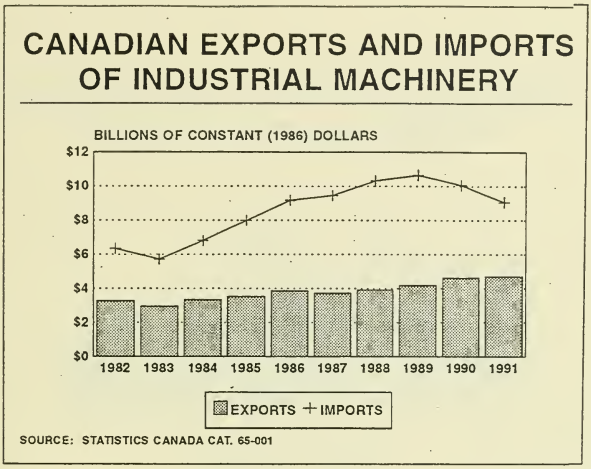

Figure A.9

parts exports in 1990 were shipped to Canada.

The average long term growth rate of the U.S. automotive parts and accessories industry is not expected to exceed 4 % annually. The constant dollar industry shipments of automotive parts and accessories, together with the predicted increase in U.S. vehicle sales, are expected to grow about 8 % in 1993. A decline in the growth rate of the parts industry and domestic vehicle sales is predicted through 1996. The sales of aftermarket motor vehicle parts is expected to return to its average annual growth rate of about 2 % as demand for repairs and maintenance is predicted to improve.

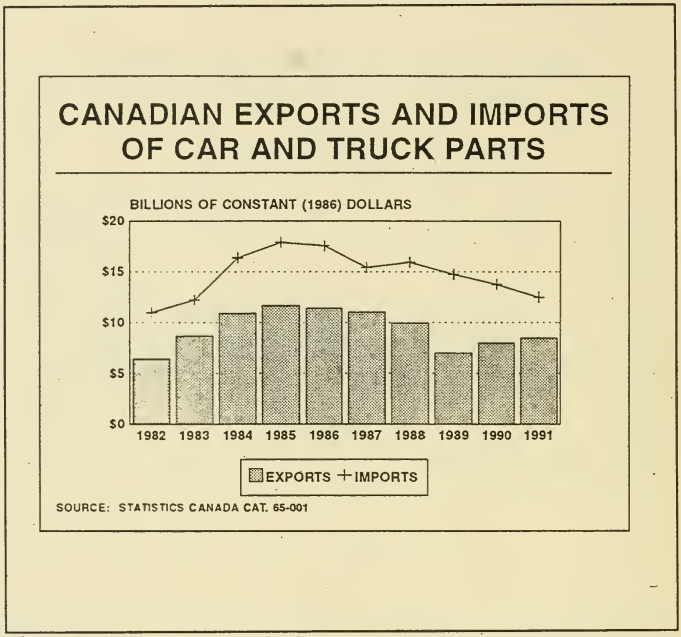

Figure A.10

Plastic use in the U.S auto industry has increased steadily over the past 5 years due to its lighter weight, lower production cost and rust and dent resistance. Industry analyst estimate that automotive related plastics use will increase by 38% by the year 2000. Ceramics, composites and silicones will be used increasingly in the 1990's.[g]

[g] U.S. Industrial Outlook 1992, Motor Vehicles and Parts Chapter. pg. 36-16 to 36-20.

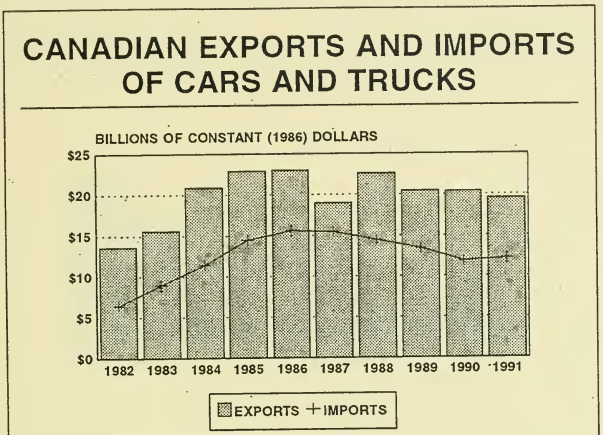

Figure A.11

Metal Casting Outlook In Ontario

It is predicted that the Metal Casting Sector may experience an increase in production throughout 1992 and 1993 due to a greater demand from auto manufacturers and engineering construction activity. However, increased competition from lower cost producers particularly in the southern U.S. and Mexico will continue to threaten the future of the metal casting industry.

In addition, the use of alternative materials, such as plastics and ceramics will continue to compete for auto part

Figure A.12

contracts in Canada. The metal casting industry is expected to specialize in technological advances and sophisticated products to maintain markets.[h]

The Foundry Management & Technology's annual foundry business survey of U.S. and Canadian Metal Casters predict that the outlook is much brighter for 1993 over 1992 with a 9.7% increase in castings production expected. The survey

[h] Canada Imperial Bank of Commerce, Economics Division, Summer 1992. pg. 49.

respondents also indicated that they will increase overall capital spending by 17.25% in 1992.[i]

Problems cited by metal casters as those faced in 1991 and expected to be faced in 1992 included the following: lack of orders, energy costs, capital availability, quality of castings, higher labour costs, imported castings and higher raw materials costs.[j]

[i] Foundry Management and Technology, January 1992, pg. 31.

[j] Foundry Management and Technology, January 1992, pg. 32.

EFFLUENT MONITORING REGULATION

PARAMETER LIST

APPENDIX B

OF THE

DEVELOPMENT DOCUMENT

Table B.1
Effluent Monitoring Regulation Parameter List

ATG	Name	Parameter
1	Chemical Oxygen Demand	Chemical Oxygen Demand (COD)
2	Total Cyanide	Total Cyanide
3	Hydrogen Ion (pH)	Hydrogen Ion (pH)
4a	Nitrogen	Ammonia plus Ammonium
		Total Kjeldahl Nitrogen (TKN)
4b		Nitrate plus Nitrite
5a	Organic Carbon	Dissolved Organic Carbon (DOC)
5b		Total Organic Carbon (TOC)
6	Total Phosphorus	Total Phosphorus
7	Specific Conductance	Specific Conductance
8	Suspended Solids	Total Suspended Solids (TSS)
		Volatile Suspended Solids (VSS)
9	Total Metals	Aluminum
		Beryllium
		Cadmium
		Total Chromium
		Cobalt
		Copper
		Lead
		Molybdenum
		Nickel
		Silver
		Thallium
		Vanadium
		Zinc
9a	Metals	Iron
		Magnesium
10	Hydrides	Antimony
		Arsenic
		Selenium
11	Chromium (Hexavalent)	Chromium (Hexavalent)
12	Mercury	Mercury
13	Total Alkyl Lead	Tetra-ethyl Lead
		Tri-ethyl Lead
14	Phenolics (4AAP)	Phenolics (4AAP)

Table B.1 (cont'd)
Effluent Monitoring Regulation Parameter List

ATG	Name	Parameter
15	Sulphide	Sulphide
16	Volatiles, Halogenated	1,1,2,2-Tetrachloroethane
		1,1,2-Trichloroethane
		1,1-Dichloroethane
		1,1-Dichloroethylene
		1,2-Dichlorobenzene
		1,2-Dichloroethane
		1,2-Dichloropropane
		1,3-Dichlorobenzene
		1,4-Dichlorobenzene
		Bromoform
		Bromomethane
		Carbon Tetrachloride
		Chlorobenzene
		Chloroform
		Chloromethane
		Cis-1,3-Dichloropropylene
		Dibromochloromethane
		Ethylene Dibromide
		Methylene Chloride
		Tetrachloroethylene
		Trans-1,2-Dichloroethylene
		Trans-1,3-Dichloropropylene
		Trichloroethylene
		Trichlorofluoromethane
		Vinyl Chloride
17	Volatiles, Non-Halogenated	Benzene
		Styrene
		Toluene
		o-Xylene
		m-Xylene and p-Xylene
18	Volatiles, Water Soluble	Acrolein
		Acrylonitrile

Table B.1 (cont'd)
Effluent Monitoring Regulation Parameter List

ATG	Name	Parameter
19	Extractable, Base Neutral	Acenaphthene
		5-Nitro Acenaphthene
		Acenaphthylene
		Anthracene
		Benz(a)anthracene
		Benzo(a)pyrene
		Benzo(b)fluoroanthene
		Benzo(g,h,i)perylene
		Benzo(k)fluoranthene
		Biphenyl
		Camphene
		1-Chloronaphthalene
		2-Chloronaphthalene
		Chrysene
		Dibenz(a,h)anthracene
		Fluoranthene
		Fluorene
		Indeno(1,2,3-cd)pyrene
		Indole
		1-Methylnaphthalene
		2-Methylnaphthalene
		Naphthalene
		Perylene
		Phenanthrene
		Pyrene
		Benzyl Butyl Phthalate
		Bis(2-ethylhexyl) Phthalate
		Di-n-butyl Phthalate
		4-Bromophenyl Phenyl Ether
		4-Chlorophenyl Phenyl Ether
		Bis(2-chloroisopropyl)ether
		Bis(2-chloroethyl)ether
		Diphenyl Ether
		2,4-Dinitrotoluene
		2,6-Dinitrotoluene

Table B.1 (cont'd)
Effluent Monitoring Regulation Parameter List

ATG	Name	Parameter
19	Extractable, Base Neutral	Bis(2-chloroethoxy)methane
		Diphenylamine
		N-Nitrosodiphenylamine
		N-Nitrosodi-n-propylamine
20	Extractables, Acid (Phenolics)	2,3,4,5-Tetrachlorophenol
		2,3,4,6-Tetrachlorophenol
		2,3,5,6-Tetrachlorophenol
		2,3,4-Trichlorophenol
		2,3,5-Trichlorophenol
		2,4,5-Trichlorophenol
		2,4,6-Trichlorophenol
		2,4-Dimethyl Phenol
		2,4-Dinitrophenol
		2,4-Dichlorophenol
		2,6-Dichlorophenol
		4,6-Dinitro-o-cresol
		2-Chlorophenol
		4-Chloro-3-methylphenol
		4-Nitrophenol
		m-Cresol
		o-Cresol
		p-Cresol
		Pentachlorophenol
		Phenol
23	Extractables, Neutral-Chlorinated	1,2,3,4-Tetrachlorobenzene
		1,2,3,5-Tetrachlorobenzene
		1,2,4,5-Tetrachlorobenzene
		1,2,3-Trichlorobenzene
		1,2,4-Trichlorobenzene
		2,4,5-Trichlorotoluene

Table B.1 (cont'd)
Effluent Monitoring Regulation Parameter List

ATG	Name	Parameter
23	Extractable, Neutral - Chlorinated	Hexachlorobenzene
		Hexachlorobutadiene
		Hexachlorocyclopentadiene
		Hexachloroethane
		Octachlorostyrene
		Pentachlorobenzene
24	Chlorinated Dibenzo-p-dioxins and Dibenzofurans	2,3,7,8-Tetrachlorodibenzo-p-dioxin
		Octachlorodibenzo-p-dioxin
		Octachlorodibenzofuran
		Total Heptachlorinated Dibenzo-p-dioxins
		Total Heptachlorinated Dibenzofurans
		Total Hexachlorinated Dibenzo-p-dioxins
		Total Hexachlorinated Dibenzofurans
		Total Pentachlorinated Dibenzo-p-dioxins
		Total Pentachlorinated Dibenzofurans
		Total Tetrachlorinated Dibenzo-p-dioxins
		Total Tetrachlorinated Dibenzofurans
25	Solvent Extractables	Oil and Grease
26	Fatty and Resin Acids	Abietic Acid
		Chlorodehydroabietic Acid
		Dehydroabietic Acid
		Isopimaric Acid
		Levopimaric Acid
		Neoabietic Acid
		Oleic Acid
		Pimaric Acid
27	Polychlorinated Biphenyls (PCBs) (Total)	PCBs (Total)
30	Anions	Fluoride

DEFINITION AND CALCULATION OF FINANCIAL INDICATORS

APPENDIX C

OF THE

DEVELOPMENT DOCUMENT

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C.1 DEFINITION AND CALCULATION OF FINANCIAL INDICATORS

I. CORPORATE/PLANT/SECTOR LEVEL INDICATORS

Liquidity Indicators

Quick Ratio (x:1)	(Current assets [less inventories] / Current liabilities)
	Quick ratio indicates the level of protection provided to short term creditors. It shows the number of dollars of liquid assets (i.e., assets that are easily convertible to cash such as marketable securities, term deposits) available to cover each dollar of current debt. A quick ratio of 1:1 or greater indicates that the business is in a liquid position.
Note:	Current assets include cash and other assets that will either be transformed into cash or will be sold or consumed within one year or within the normal operating cycle of the business, if longer than one year.
Current Ratio (x:1)	(Current assets / Current liabilities)
	Current ratio indicates the degree to which a company has sufficient current assets to cover current liabilities. The higher the ratio the greater the assurance that current liabilities can be met. A current ratio of 2:1 or better is generally considered desirable.
Net Working Capital to Total Assets (%)	{(Current assets - Current liabilities) / Total assets} x 100
	Net working capital to total assets ratio indicates the proportion of total company assets which are currently available to cover unexpected expenses.

Solvency Indicators

Total Debt to Total Assets (%)	(Total debt / Total assets) x 100
	Total debt to total assets measures the degree to which a company is leveraged (i.e., financed by outside debt). A higher total debt/total assets ratio indicates that the company is highly leveraged which may limit their ability to raise additional capital (at a reasonable interest rate) to finance large capital expenditures.

Interest Coverage (Times)	(Net income before interest, extra-ordinary items and all taxes) / Annual interest charges. Interest coverage provides information on the extent to which a company's normal operating income is sufficient to cover annual interest charges. A company with a low interest coverage ratio may be unable to pay its annual interest charges and would therefore have a higher risk of being forced into insolvency by creditors.
Cash Flow ($)	Net income before extraordinary items and all non-cash expenses (e.g., depreciation, amortization, deferred taxes) Cash flow provides a measure of a company's ability to pay dividends and finance expansion. A company which shows little net after-tax profit may still be able to meet its short term debts and obligations if cash flow is adequate.
Cash Flow to Total Debt (Beaver's Ratio) (%)	{(Net income before extraordinary items, depreciation and deferred taxes) / Total debt} x 100 Cash flow to total debt indicates the percentage of total debt which is covered by current cash flow. This should be considered in relation to the number of years the debt is being amortized.

Profitability Indicators

Return on Assets (%)	{Net income (before interest and extraordinary items but after taxes)}/Total assets x 100 Return on assets is a key indicator of a company's profitability. It matches net after-tax profits (from normal operations) with the assets available to earn a return. Companies that are using their assets efficiently will have a relatively high rate of return. Excluding interest from the definition of normal operating income eliminates any bias resulting from a company's decision to finance assets through long term debt versus raising additional capital internally (i.e, through issuing shares).
Return on Net Assets (RONA) (%)	{Net income (before interest and extraordinary items but after taxes) / (Total assets - Total liabilities)} x 100 Similar to return on assets except the return is expressed as a percentage of net assets.

Earnings Before Interest but After Taxes to Total Assets (EBIAT/TA) (%)	(Net income before interest but after taxes / Total assets) x 100 Similar to return on assets (above) except the definition of net income includes extraordinary items.
Earnings Before Interest and Taxes to Total Assets (EBIT/TA) (%)	(Net income before interest and all taxes / Total assets) x 100 Similar to return on assets (above) except the net income is before taxes and includes extraordinary items.
Return on Sales (Profit Margin) (%)	{Net income (after taxes)/ Sales} x 100 Return on sales measures the profits earned per dollar of sales indicating the profitability of the company. It also indicates the company's ability to survive adverse conditions such as falling prices, rising costs and declining sales.
Return on Capital % current	{Net income (after taxes) plus after tax interest charges and extraordinary items / Total assets Employed less liabilities} x 100 This measures the rate of return being earned on company assets employed in operations. It provides an indication of the level of incentive for owners and investors to remain in that particular enterprise.
Net Income $	Total revenue less all expenses (cost of sales, (Profit) operating expenses, taxes)

Efficiency Indicators

Total Assets Sales (%)	(Total Assets/Sales) x 100 Total assets to sales indicates the level of investment that is required to generate those sales. A high percentage (in comparison to industry averages) may indicate that the company is not using assets efficiently or needs to market its product more aggressively.

Other Indicators

Amortized and Total Recorded Regulatory Capital Costs as a Percent Recorded Capital Expenditures (%)	(Amortized or Total Regulatory Capital Cost/Total Capital Expenditures) x 100 This ratio indicates the extent to which capital requirements implied by regulatory requirements would divert available capital resources from other uses.
Regulatory Operating Expenses as a Percent of Recorded Operating Expenditures (%)	(Regulatory-induced Annual Operating Expenses/ Recorded operating and maintenance expenses)x100 This ratio indicates the extent to which operating and maintenance expenses would increase due regulatory-induced operating costs.

II. DIVISION/PLANT LEVEL INDICATORS

Profitability Indicators

Operating profits	Total revenue less operating expenses ($) (includes cost of sales)
Return on Assets (%)	(Operating profits / Assets) x 100 Key indicator to assess divisional profitability. It also provides a rough assessment of the return on investment at the level of the division.
Return on Sales (%)	(Operating profits / Sales) x 100 Assesses a division's capacity to withstand unfavourable market conditions such as falling product prices, rising input costs or depressed sales volumes.
Return per Unit of production ($/unit)	Operating profits / Sales volume or units This ratio measures the contribution of each unit of sale to profits. In conjunction with the expenses index, it provides a composite assessment of a division's efficiency in converting raw materials to consumable products.

Efficiency

Expenses to Sales (%)	(Expenses / Sales) x 100 This ratio shows the proportion of sales revenue that goes towards the recovery of production costs. The lower this ratio the higher the division's profits.
Cost per Unit ($/unit)	Expenses / Sales volume (quantity) Indicates the unit cost of manufacturing the product.

PROCEDURE FOR ADJUSTING FINANCIAL DATA

Key Figures Impacted		Debt Financing Option Amounts for Impact
Balance Sheet		
-Fixed Assets	Add:	Capital cost of abatement (& monitoring) less 1st year depreciation.
-Other Current Assets	Deduct:	Current years payment on long-term debt (LTD)
-Current Portion	Add:	Current portion of LTD, of LT Debt principal payable within the next year.*
-Long Term Debt	Add:	Year end balance of LTD related to abatement costs (Initial capital cost less 1st year (amortized) payment and current portion for following year).*
-Share Capital	Add:	N/A
-Retained Earnings	Add:	After abatement net income (less pre-abatement net income)
Income Statement		
-Depreciation	Add:	1 year of depreciation of capital costs.
-Interest	Add:	1st year interest on LTD.*
-Operating Expenses	Add:	Annual O&M (monitoring and abatement) costs.
-Current Income Taxes	Deduct:	Tax impact of higher interest, O&M and capital costs** (use capital cost allowance (CCA) rate of 25 or 35.9%).
-Net Income		Previous net income adjusted for impact of above changes.
Other		
-Capital Exp.	Add:	Capital exp. for abatement and monitoring

* Appropriate amounts can be determined from completing the 1st two years of a loan amortization schedule.

** Interest expense determined as an internal cost of capital

CALCULATION OF CAPITAL COST RECOVERY AND NET PRESENT VALUE OF TAX SAVINGS

1. **SIMPLE CASE:**

Interest Rate (i) = 12%, Useful Life (n) = 10 years,
Income Tax rate (T) = 40%,
Capital Recovery Factor (cf) = 0.113

2. **DETERMINING TAX SAVINGS:**

i = 12%, n = 10 years, income tax (T) = 40%,

Capital Cost Allowance (CCA) rate = 25/50/25%

Tax savings claimable = (investment x CCA rate x income tax rate)

The following worked example is base on $1 investment made in year 1:

	Year 1	Year 2	Year 3
Investment	$1		
CCA rate applicable	0.25%	0.50%	0.25%
Tax Savings	$0.10 ($1*0.25*0.40)	$0.20	$0.10
NPV factors	&41.000	0.8290	0.7972

Present Value of Tax Savings:

Year 1 = 0.1000 (0.1*1.0000)
Year 2 = 0.1790 (0.2*0.8290)
Year 3 = 0.0800 (0.1*0.7972)
TOTAL = 0.3590

After Tax Investment = 0.6410 (1-0.3590)

For every $1 invested in environmental control $0.359 is recouped in tax savings. Therefore, the effective capital outlay is $0.641 (i.e., $1 - $0.359).

3. **CAPITAL RECOVERY:**

After Tax Capital Recovery = 0.113

Before Tax Recovery = 0.188 (0.113/0.6)

TABLE C.1
A COMPARISON OF THE IMPACT OF THE MOST COST-EFFECTIVE OPTION
COST ESTIMATES ON THE **FORD PLANT LEVEL HISTORICAL PERFORMANCE**

Financial Indicators	Units of Financial Indicators	Worst Year (Lowest Operating Income) 1991	TEN YEAR AVERAGE			1991		
			Financial Indicators Before Regulatory Costs	Financial Indicators After Regulatory Costs	Change	Financial Indicators Before Regulatory Costs	Financial Indicators After Regulatory Costs	Change
Net Income	$'000s	-208,900.0	143,177.8	142,866.9	-310.9	-208,900.0	-209,528.1	-628.1
Change in Net Income	%	-	-	-0.2	-0.2	-	0.3	0.3
Operating Income	$'000s	-217,500.0	181,511.1	180,883.0	-628.1	-217,500.0	-218,128.1	-628.1
Internal Cash Flow	$'000s	93,500.0	381,522.2	381,321.3	-200.9	93,500.0	92,981.9	-518.1
Current Ratio	Times	0.9	1.1	1.1	0.0	0.9	0.9	0.0
Quick Ratio	Times	0.5	0.6	0.6	0.0	0.5	0.5	0.0
Interest Coverage	Times	-3.5	7.4	7.4	0.0	-3.5	-3.5	0.0
Return on Capital Employed	%	-8.8	9.3	9.3	0.0	-8.8	-8.8	0.0
Return on Assets	%	-4.2	5.2	5.2	0.0	-4.2	-4.2	0.0
Return on Sales	%	-1.7	1.1	1.1	0.0	-1.7	-1.7	0.0
EBIAT/Total Assets	%	-4.2	5.6	5.6	0.0	-4.2	-4.2	0.0
EBIT/Total Assets	%	-6.4	9.2	9.2	0.0	-6.4	-6.4	0.0
Cash Flow to Debt	Times	4.2	18.9	18.9	0.0	4.2	4.2	0.0
MISA Capital Costs/Capital Expenditures	%	-	-	0.0	0.0	-	0.1	0.1
Total Debt to Total Assets	Times	64.7	62.9	62.9	0.0	64.7	64.7	0.0
Working Capital to Assets	Times	-3.2	5.3	5.3	0.0	-3.2	-3.3	-0.1

TABLE C.2

A COMPARISON OF THE IMPACT OF THE MOST COST-EFFECTIVE OPTION
COST ESTIMATES ON THE **HALEY INDUSTRIES PLANT LEVEL HISTORICAL PERFORMANCE**

Financial Indicators	Units of Financial Indicators	Worst Year (Lowest Operating Income) 1991	TEN YEAR AVERAGE			1991		
			Financial Indicators Before Regulatory Costs	Financial Indicators After Regulatory Costs	Change	Financial Indicators Before Regulatory Costs	Financial Indicators After Regulatory Costs	Change
Net Income	$'000s	458.0	3,206.3	3,105.3	-101.0	1,404.0	1,303.0	-101.0
Change in Net Income	%	-	-	-3.1	-3.2	-	-7.2	-7.2
Operating Income	$'000s	875.0	5,316.9	5,141.7	-175.2	2,396.0	2,220.8	-175.2
Internal Cash Flow	$'000s	1,577.0	4,364.2	4,270.1	-94.1	2,686.0	2,591.9	-94.1
Current Ratio	Times	6.3	4.3	4.2	-0.1	6.1	5.9	-0.2
Quick Ratio	Times	4.9	3.1	3.0	-0.1	4.7	4.6	-0.1
Interest Coverage	Times	2.0	51.7	46.6	-5.1	3.6	3.4	-0.2
Return on Capital Employed	%	1.9	10.3	10.1	-0.2	4.1	3.9	-0.2
Return on Assets	%	2.4	9.4	9.1	-0.3	4.5	4.3	-0.2
Return on Sales	%	1.8	10.7	10.4	-0.3	4.5	4.2	-0.3
EBIAT/Total Assets	%	2.4	9.4	9.1	-0.3	4.5	4.3	-0.2
EBIT/Total Assets	%	3.0	16.1	15.6	-0.5	6.3	6.0	-0.3
Cash Flow to Debt	Times	6.8	34.5	33.4	-1.1	11.5	11.0	-0.5
MISA Capital Costs/Capital Expenditures	%	-	-	0.7	0.7	-	1.0	1.0
Total Debt to Total Assets	Times	46.5	35.9	36.3	0.4	45.8	46.1	0.3
Working Capital to Assets	Times	32.3	33.5	33.1	-0.4	31.2	31.0	-0.2

Figure C.1

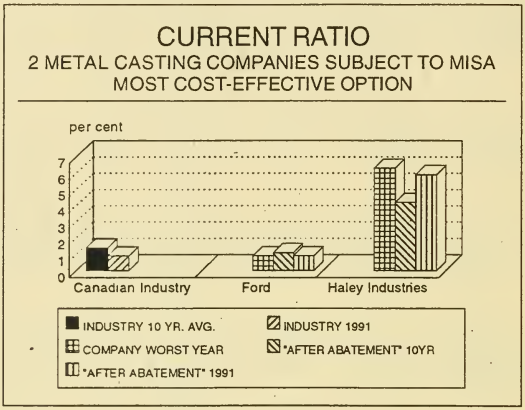


Figure C.2

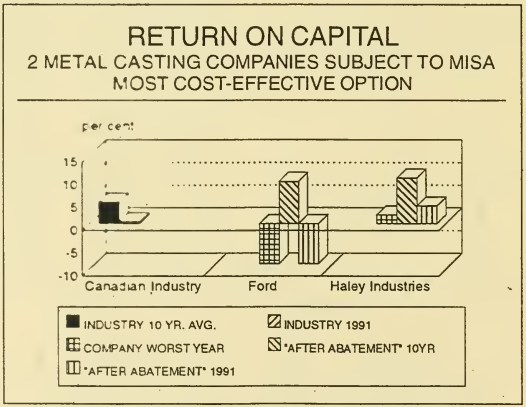
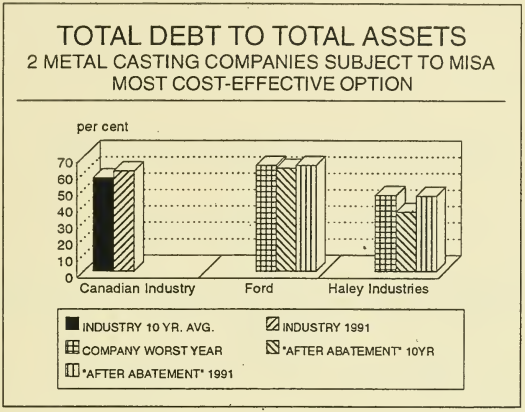


Figure C.3



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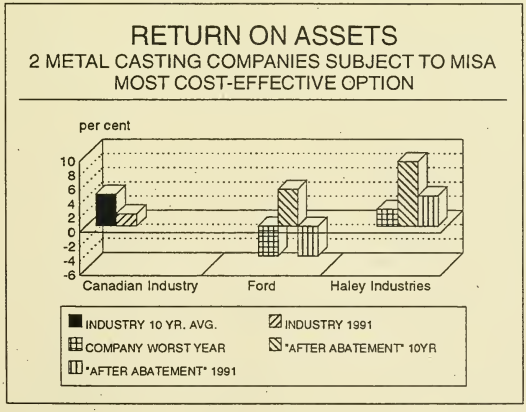

ONTARIO REGULATION ???/??

REGULATION MADE UNDER THE
ENVIRONMENTAL PROTECTION ACT

EFFLUENT MONITORING AND EFFLUENT LIMITS

METAL CASTING SECTOR

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ONTARIO REGULATION ??/??

REGULATION MADE UNDER THE
ENVIRONMENTAL PROTECTION ACT

EFFLUENT MONITORING AND EFFLUENT LIMITS - PETROLEUM SECTOR

PART I - GENERAL

Interpretation

1.-(1) In this Regulation,

"assessment parameter" means a parameter that is listed in Schedule 3;

"blowdown water" means recirculating water that is discharged from a cooling water system for the purpose of controlling the level of water in the cooling water system or for the purpose of discharging from the cooling water system materials contained in the cooling water system the further build-up of which would impair the operation of the system;

"cooling water effluent" means water and associated material that is used in an industrial process for the purpose of removing heat and that has not, by design, come into contact with process materials, but does not include blowdown water;

"cooling water effluent monitoring stream" means a cooling water effluent stream on which a sampling point is established under section 8;

"cooling water effluent sampling point" means a sampling point established on a cooling water effluent stream under section 8;

"Director", in relation to obligations of a discharger, means a Director appointed under section 5 of the Act and responsible for the region in which the discharger's plant is located and includes an alternate named by the Director;

"discharger" means an owner or person in occupation or having the charge, management or control of a plant to which this Regulation applies;

"limited parameter", in relation to a plant, means a parameter for which a limit is specified for the plant in column 3 or 4 of Schedule 2;

"pick up", in relation to a sample, means pick up for the purpose of transportation to and analysis at a laboratory;

"plant" means an industrial facility and the developed property, waste disposal sites and wastewater treatment facilities associated with it;

"process change" means a change in equipment, production processes, process materials or treatment processes;

"process effluent" means,

(a) effluent that, by design, has come into contact with process materials,

(b) blowdown water,

(c) effluent that results from cleaning or maintenance operations at a plant during a period when all or part of the plant is shut down, and

(d) any effluent described in clauses (a) to (c) combined with cooling water effluent or storm water effluent;

"process effluent monitoring stream" means a process effluent stream on which a sampling point is established under section 8;

"process effluent sampling point" means a sampling point established on a process effluent stream under section 8;

"process materials", in relation to a discharger's plant, means raw materials for use in an industrial process at the plant, manufacturing intermediates produced at the plant, or products or by-products of an industrial process at the plant, but does not include chemicals added to cooling water for the purpose of controlling organisms, fouling and corrosion;

"quarter" means all or part of a period of three consecutive months beginning on the first day of January, April, July or October;

"semi-annual period" means all or part of a period of six months beginning on the first day of January or July;

"storm water effluent" means run-off from a storm event or thaw that is not used in any industrial process.

(2) For greater certainty, this Regulation applies both to effluent streams that discharge continuously and to effluent streams that discharge intermittently.

(3) An obligation on a discharger to do a thing under this Regulation is discharged if another person has done it on the discharger's behalf.

Purpose

2. The purpose of this Regulation is to monitor and control the quality of effluent discharged from the plants listed in Schedule 1.

Application

3.-(1) This Regulation applies only with respect to the plants listed in Schedule 1.

(2) This Regulation does not apply with respect to the discharge of effluent to a municipal sewer.

Obligations Under Approvals, Orders, etc.

4. Nothing in this Regulation shall be interpreted to limit or reduce a discharger's obligations under an approval, order, direction or other instrument issued under any Act.

Non-application of General Effluent Monitoring Regulation

5. This Regulation is not a Sectoral Effluent Monitoring Regulation within the meaning of Ontario Regulation 695/88.

By-passes

6. Beginning on _____, 199_, a discharger shall not permit process effluent to be discharged from the discharger's plant unless the process effluent flows past a sampling point established on a process effluent stream in accordance with this Regulation before being discharged.

(The date on which Part IV of this Regulation comes into force will be inserted in section 6.)

Sampling and Analytical Procedures

7.-(1) Each discharger shall carry out the establishment of sampling point obligations of this Regulation and the sampling and analysis obligations of this Regulation, including quality control sampling and analysis obligations, in accordance with the procedures described in the Ministry of Environment and Energy publication entitled "Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater", dated July, 1993.

(2) Each discharger shall maintain the sampling equipment used at the discharger's plant for sampling required by this

Regulation in a way that ensures that the samples collected at the plant under this Regulation accurately reflect the level of discharge of each limited parameter and assessment parameter from the plant.

PART II - SAMPLING POINTS

Establishment and Elimination of Sampling Points

8.-(1) Each discharger shall, by _____, 199_, establish a sampling point on each process effluent and cooling water effluent stream at the discharger's plant, as necessary so that the plant loadings calculated under sections 12 and 13 for each limited parameter and assessment parameter, accurately reflect the level of discharge of each such parameter from the plant.

(The date that is 90 days after the day on which this Regulation is filed will be inserted in subsection 8(1).)

(2) If circumstances change so that a new sampling point is necessary at a discharger's plant in order to permit the calculation of plant loadings under sections 12 and 13 for each limited parameter and assessment parameter that accurately reflect the level of discharge of each such parameter from the plant, the discharger shall, within thirty days of the change, establish the new sampling point.

(3) A discharger may eliminate a sampling point established under subsection (1) or (2) if the sampling point is no longer necessary to permit the calculation of plant loadings under sections 12 and 13 for each limited parameter and assessment parameter that accurately reflect the level of discharge of each such parameter from the plant.

(4) For the purposes of this section, a plant loading for a parameter that is based on analytical results that are significantly affected by dilution or masking due to the merging of streams upstream of a sampling point at a plant is not a loading that accurately reflects the level of discharge of the parameter from the plant.

(5) In determining what is necessary to meet a discharger's obligations to establish sampling points under this section, the discharger shall consider both which streams should have sampling points and where on a stream a sampling point should be located.

Reports on Sampling Points

9.-(1) By _____, 199_, each discharger shall submit to the Director a list and plot plan showing the sampling points

established under this Regulation at the discharger's plant as of _____ __, 199__.

(The date that is 100 days after the day on which this Regulation is filed will be inserted in the first line of subsection 9(1). The date that is 90 days after the day on which this Regulation is filed will be inserted in the fourth line of subsection 9(1).)

(2) Within thirty days after establishing a sampling point under this Regulation that is not shown on a list and plot plan submitted under this section, the discharger shall give the Director a written notice describing the location of the sampling point, together with a revised list and plot plan showing the sampling point.

(3) Within thirty days after eliminating a sampling point under this Regulation that is shown on a list and plot plan submitted under this section, the discharger shall give the Director a written notice describing where the sampling point used to be, together with a revised list and plot plan without the sampling point.

Use of Sampling Points Established Under This Part

10. Subject to section 20, each discharger shall use the sampling points established under this section for all sampling required by this Regulation.

PART III - CALCULATION OF LOADINGS

Calculation of Loadings - General

11.-(1) For the purposes of performing a calculation under sections 12 and 13, a discharger shall use the actual analytical result obtained by the laboratory.

(2) Despite subsection (1), where the actual analytical result is less than one-tenth of the analytical method detection limit set out in the Ministry of Environment and Energy publication entitled "Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater" dated July, 1993, the discharger shall use the value zero for the purpose of performing a calculation under sections 12 and 13.

(3) Each discharger shall ensure that each calculation of a process effluent loading required by section 12 is performed as soon as reasonably possible after the analytical result on which the calculation is based becomes available to the discharger.

(4) Each discharger shall ensure that each calculation of a cooling water effluent loading required by section 13 is performed in time to comply with subsection 32(4).

Calculation of Loadings - Process Effluent

12.-(1) Each discharger shall calculate, in kilograms, a daily process effluent stream loading for each limited parameter in each process effluent monitoring stream of the discharger for each day on which a sample is collected under this Regulation from the stream for analysis for the parameter.

(2) When calculating a daily stream loading under subsection (1), the discharger shall multiply, with the necessary adjustment of units to yield a result in kilograms, the analytical result obtained from the sample for the parameter by the daily volume of effluent, as determined under section 25, for the stream for the day.

(3) Each discharger shall calculate, in kilograms, a daily process effluent plant loading for each limited parameter for each day for which the discharger is required to calculate a daily process effluent stream loading for the parameter under subsection (1).

(4) For the purposes of subsection (3), a daily process effluent plant loading for a parameter for a day is the sum, in kilograms, of the daily process effluent stream loadings for the parameter calculated under subsection (1) for the day.

(5) Where a discharger calculates only one daily process effluent stream loading for a parameter for a day under subsection (1), the daily process effluent plant loading for the parameter for the day for the purposes of subsection (3) is the single daily process effluent stream loading for the parameter for the day.

(6) Each discharger shall calculate, in kilograms, a monthly average process effluent plant loading for each limited parameter for each month in which a sample is collected under this Regulation more than once from a process effluent monitoring stream at the discharger's plant for analysis for the parameter.

(7) For the purposes of subsection (6), a monthly average process effluent plant loading for a parameter for a month is the arithmetic mean of the daily process effluent plant loadings for the parameter calculated under subsection (3) for the month.

Calculation of Loadings - Cooling Water

13.-(1) Each discharger shall calculate, in kilograms, a daily cooling water effluent stream loading for each assessment parameter in each cooling water effluent monitoring stream of the discharger for each day on which a sample is collected under this Regulation from the stream for analysis for the parameter.

(2) When calculating a daily stream loading under subsection (1), the discharger shall multiply, with the necessary adjustment of units to yield a result in kilograms, the analytical result obtained from the sample for the parameter by the daily volume of effluent, as determined under section 25, for the stream for the day.

(3) Each discharger shall calculate, in kilograms, a daily cooling water effluent plant loading for each assessment parameter for each day for which the discharger is required to calculate a daily cooling water effluent stream loading for the parameter under subsection (1).

(4) For the purposes of subsection (3), a daily cooling water effluent plant loading for a parameter for a day is the sum, in kilograms, of the daily cooling water effluent stream loadings for the parameter calculated under subsection (1) for the day.

(5) Where a discharger calculates only one daily cooling water effluent stream loading for a parameter for a day under subsection (1), the daily cooling water effluent plant loading for the parameter for the day for the purposes of subsection (3) is the single daily cooling water effluent stream loading for the parameter for the day.

(6) Each discharger shall calculate, in kilograms, a monthly average cooling water effluent plant loading for each assessment parameter for each month in which a sample is collected under this Regulation more than once from a cooling water effluent monitoring stream at the discharger's plant for analysis for the parameter.

(7) For the purposes of subsection (6), a monthly average cooling water effluent plant loading for a parameter for a month is the arithmetic mean of the daily cooling water effluent plant loadings for the parameter calculated under subsection (3) for the month.

PART IV - PARAMETER AND LETHALITY LIMITS

Parameter Limits

14.-(1) Each discharger shall ensure that each daily process effluent plant loading calculated for a parameter under section 12 in connection with the discharger's plant does not exceed the daily plant loading limit specified for the parameter and the plant in Column 3 of Schedule 2.

(2) Each discharger shall ensure that each monthly average process effluent plant loading calculated for a parameter under section 12 in connection with the discharger's plant does not

exceed the monthly average plant loading limit specified for the parameter and the plant in Column 4 of Schedule 2.

(3) Subject to subsection (4), each discharger shall control the quality of each process effluent monitoring stream at the discharger's plant to ensure that the pH value of any sample collected at a process effluent sampling point at the plant is within the range of 6.0 to 9.5.

(4) Throughout any day on which a discharger has used an alternate sampling point on a process effluent monitoring stream for sampling required by section 20, as permitted by subsections 20(7) and (8), the discharger,

(a) shall control the quality of the stream to ensure that the pH value of any sample collected at the alternate sampling point on the stream is within the range of 6.0 to 9.5; and

(b) need not comply with subsection (3) with respect to the stream.

Lethality Limits

15. Each discharger shall control the quality of each process effluent monitoring stream and each cooling water effluent monitoring stream at the discharger's plant to ensure that each rainbow trout acute lethality test and each Daphnia magna acute lethality test performed on any grab sample collected at a process effluent sampling point or cooling water effluent sampling point at the plant results in mortality for no more than fifty percent of the test organisms in one-hundred percent effluent.

PART V - MONITORING

Monitoring - General

16.-(1) Despite sections 17 to 24, a discharger need not collect samples from any stream at the discharger's plant on a day on which there is no process effluent that is being discharged from the plant.

(2) Where a discharger is required by this Regulation to pick up a set of samples and analyze it for certain parameters the discharger shall pick up a set of samples sufficient to allow all the analyses to be performed.

(3) A discharger shall use all reasonable efforts to ensure that all analyses required by this Regulation are completed as soon as reasonably possible and that the results of those analyses are made available to the discharger as soon as reasonably possible.

(4) Subject to subsection (5), each discharger shall pick up all sets of samples required to be picked up at the discharger's plant under sections 17 and 18 between the hours of 7.00 a.m. and 10.00 a.m..

(5) If the Director is satisfied, on the basis of written submissions from a discharger, that the circumstances at the discharger's plant are such that it would be impractical to pick up a set of samples from each sampling point established at the plant under this Regulation within the time period specified in subsection (4), the Director may give the discharger a written notice in respect of the plant, varying the time period specified in subsection (4).

(6) Subject to subsections (7) and (8), where a discharger is required by section 17 or 18 to pick up a set of samples the discharger shall pick up a set collected over the twenty-four hour period immediately preceding the pick-up.

(7) The twenty-four hour period referred to in subsection (6) may be shortened or enlarged by up to three hours to permit a discharger to take advantage of the three hour range specified in subsection (4) or of a different three hour period specified in a notice under subsection (5).

(8) Where a notice has been given under subsection (5) in respect of a plant specifying a time period longer than three hours, the twenty-four hour period referred to in subsection (6) may be shortened or enlarged by up to that longer amount of time to permit the discharger to take advantage of the time period specified in the notice.

(9) If the circumstances at a plant change so that the Director is satisfied that the circumstances described in subsection (5) no longer apply at the plant, the Director may revoke a notice given in respect of a plant under subsection (5) by giving a notice of revocation in writing to a discharger for the plant.

Monitoring - Process Effluent - Daily

17.-(1) Each discharger shall, on each day, pick up a set of samples collected at each process effluent sampling point at the discharger's plant and shall analyze each set of samples for the parameters for which the frequency of monitoring, as set out in column 2 of Schedule 2 for the discharger's plant, is daily.

(2) A discharger need not meet the requirements of subsection (1) where it is impossible to do so because of sampling by a provincial officer.

Monitoring - Process Effluent - Weekly

18.-(1) Each discharger shall, on one day in each week, pick up a set of samples collected at each process effluent sampling point at the discharger's plant and shall analyze each set of samples for the parameters for which the frequency of monitoring, as set out in column 2 of Schedule 2 for the discharger's plant, is weekly.

(2) There shall be an interval of at least four days between successive pick-up days at the plant under subsection (1).

(3) All samples picked up under subsection (1) in a week shall be picked up on the same day in the week.

Monitoring - Process Effluent - Quality Control

19.-(1) On one day in each year after 1993, on a day on which samples are picked up at the plant under subsection 18(1), each discharger shall collect and pick up a duplicate sample for each sample picked up on that day under subsection 18(1) at one process effluent sampling point at the discharger's plant and shall analyze each duplicate sample for the parameters for which the frequency of monitoring, as set out in column 2 of Schedule 2 for the discharger's plant, is weekly.

(2) Each discharger shall prepare a travelling blank and travelling spiked blank sample for each sample for which a duplicate sample is picked up at the plant under subsection (1) and shall analyze the travelling blank and travelling spiked blank samples in accordance with the directions set out in the Ministry of Environment and Energy publication entitled "Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater", dated July, 1993.

(3) There shall be an interval of at least six months between successive pick-up days at the plant under subsection (1).

Monitoring - Process Effluent - pH Measurement

20.-(1) Each discharger shall, on each day during the time period applicable to the plant under subsection 16(4) or (5), collect a grab sample from each process effluent monitoring stream at the discharger's plant and shall analyze each sample for the parameter pH.

(2) Each discharger shall, within each twenty-four hour period beginning with the collection of the first grab sample at the plant under subsection (1) on each day, collect two more grab samples from each process effluent monitoring stream at the

discharger's plant and shall analyze each sample for the parameter pH.

(3) There shall be an interval of at least four hours between each of the three collections at a stream under subsections (1) and (2) in each twenty-four hour period.

(4) Each grab sample collected under subsections (1) and (2) shall be picked up within twenty-four hours of when it was collected.

(5) Instead of complying with subsections (1) to (4) with respect to a stream, a discharger may use an on-line analyzer at the sampling point on the stream and analyze the effluent at the sampling point for the parameter pH once in each day during the time period applicable to the plant under subsection 16(4) or (5), and two more times in each twenty-four hour period beginning with the first analysis at the plant under this subsection in each day.

(6) There shall be an interval of at least four hours between each of the three analyses at a sampling point under subsection (5) in each twenty-four hour period.

(7) For the purposes of this section, a discharger shall use either the sampling point established under section 8 on the stream or an alternate sampling point located downstream of the sampling point but before the point of discharge of the stream to surface water or to an industrial sewer used in common with another plant.

(8) Before using an alternate sampling point under subsection (7), a discharger shall give the Director a written notice describing the location of the alternate sampling point, together with a revised version of the list and plot plan submitted under section 9 showing the alternate sampling point.

Monitoring - Acute Lethality Testing - Rainbow Trout

21.-(1) Where a discharger is required by this section to perform a rainbow trout acute lethality test, the discharger shall perform the test according to the procedures described in the Environment Canada publication entitled "Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout", dated July, 1990.

(2) Each rainbow trout acute lethality test required by this section shall be carried out as a single concentration test using one hundred percent effluent.

(3) On one day in each month, on a day on which samples are picked up at the plant under subsection 18(1), each discharger

shall collect and immediately pick up a grab sample at each process effluent sampling point at the discharger's plant and shall perform a rainbow trout acute lethality test on each sample.

(4) There shall be an interval of at least fifteen days between successive pick-up days at the plant under subsection (3).

(5) All samples picked up under subsection (3) in a month shall be picked up on the same day in the month.

(6) Where a discharger has performed tests under subsection (3) for twelve consecutive months on samples collected from the same sampling point and the mortality of the rainbow trout in each test did not exceed fifty percent, the discharger is relieved of the obligations under subsection (3) relating to the sampling point and shall instead collect and immediately pick up a grab sample at the sampling point on one day in each quarter and perform a rainbow trout acute lethality test on each sample.

(7) Samples picked up at a plant under subsection (6) shall be picked up on a day on which samples are picked up at the plant under subsection (3).

(8) If no samples are being picked up at a plant under subsection (3) during a quarter, samples picked up at the plant during the quarter under subsection (6) shall be picked up on a day on which samples are picked up at the plant under subsection 18(1).

(9) There shall be an interval of at least forty-five days between successive pick-up days at the plant under subsection (6).

(10) All samples picked up under subsection (6) in a quarter shall be picked up on the same day in the quarter.

(11) If a rainbow trout acute lethality test performed under subsection (6) on any sample from a sampling point results in mortality of more than fifty percent of the test rainbow trout, subsections (6) to (10) cease to apply in respect to samples from that sampling point, and a discharger shall instead comply with the requirements of subsection (3) relating to the sampling point, until the tests performed under subsection (3) on all samples collected from the sampling point for a further twelve consecutive months result in mortality for no more than fifty per-cent of the rainbow trout for each test.

(12) A discharger shall notify the Director in writing of any change in the frequency of acute lethality testing under this Regulation at the discharger's plant, within thirty days after the day on which the change begins.

(13) A discharger may notify the Director in writing of any period in which the testing of samples collected at a sampling point under subsection (3) would always result in mortality of more than fifty percent of the test rainbow trout.

(14) Where a notice is given under subsection (13), a discharger is relieved of the obligations under subsection (3) relating to the sampling point during the period in which the testing of samples collected at the sampling point would always result in mortality of more than fifty percent of the test rainbow trout.

(15) Subsections (13) and (14) are revoked on _____ __, 199_.

(The date on which Part IV of this Regulation comes into force will be inserted in subsection 21 (15).)

(16) Subsections (2) to (15) apply with necessary modifications to each cooling water effluent sampling point and, for the purpose, the reference in subsection (3) to each process effluent sampling point shall be deemed to be a reference to each cooling water effluent sampling point and the reference in subsections (3) and (8) to subsection 18(1) shall be deemed to be a reference to subsection 24(1).

Monitoring - Acute Lethality Testing - Daphnia magna

22.-(1) Where a discharger is required by this section to perform a Daphnia magna acute lethality test, the discharger shall perform the test according to the procedures described in the Environment Canada publication entitled "Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Daphnia magna", dated July, 1990.

(2) Subsections 21(2) to (15) apply with necessary modifications to Daphnia magna acute lethality tests and, for the purpose, a reference to rainbow trout shall be deemed to be a reference to Daphnia magna.

(3) Each discharger shall pick up each set of samples required to be collected from a sampling point at the discharger's plant under this section on a day on which the discharger collects a sample from the sampling point under section 21, to the extent possible having regard to the frequency of monitoring required at the sampling point under this section and section 21.

Monitoring - Chronic Toxicity Testing - Fathead Minnow and Ceriodaphnia Dubia

23.-(1) Where a discharger is required to perform a 7-day

fathead minnow growth inhibition test, the discharger shall perform the test according to the procedure described in the Environment Canada publication entitled "Biological Test Method: Test of Larval Growth and Survival Using Fathead Minnows" dated February, 1992.

(2) Where a discharger is required to perform a 7-day Ceriodaphnia dubia reproduction inhibition and survivability test, the discharger shall perform the test according to the procedure described in the Environment Canada publication entitled "Biological Test Method: Test of Reproduction and Survival Using the Cladoceran Ceriodaphnia dubia", dated February, 1992.

(3) On one day in each semi-annual period, on a day on which samples are picked up at the plant under subsection 18(1), each discharger shall collect and immediately pick up a grab sample from each process effluent sampling point at the discharger's plant, and shall perform a 7-day fathead minnow growth inhibition test and a 7-day Ceriodaphnia dubia reproduction inhibition and survivability test on each sample.

(4) There shall be an interval of at least ninety days between successive pick-up days at the plant under subsection (3).

(5) All samples picked up under subsection (3) in a semi-annual period shall be picked up on the same day in the semi-annual period.

(6) A discharger need not collect a sample from a sampling point in accordance with subsection (3) until twelve consecutive monthly rainbow trout acute lethality tests and twelve consecutive monthly Daphnia magna acute lethality tests performed on samples collected at the sampling point at a discharger's plant result in mortality for no more than fifty percent of the test organisms in one hundred percent effluent.

Monitoring - Cooling Water Effluent - Weekly Assessment

24.-(1) Each discharger shall, on one day in each week, pick up a set of samples collected at each cooling water effluent sampling point at the discharger's plant and shall analyze each set of samples for each assessment parameter listed in Schedule 3 for that discharger's plant.

(2) There shall be an interval of at least four days between successive pick-up days at the plant under subsection (1).

(3) All samples picked up under subsection (1) in a week shall be picked up on the same day in the week.

PART VI - EFFLUENT VOLUME

Flow Measurement

25.-(1) For the purposes of this section, a volume of effluent for a stream for a day is the volume that flowed past the sampling point established under Part II on the stream during the twenty-four hour period preceding the pick-up of the first sample picked up from the stream for the day.

(2) Each discharger shall determine in cubic metres a daily volume of effluent for each process effluent stream at the discharger's plant for each day on which a sample is collected under this Regulation from the stream, by integration of continuous flowrate measurements.

(3) Despite subsection (2), where a process effluent stream discharges on an intermittent basis, the daily volumes for the stream may be determined either by integration of continuous flowrate measurements or by the summation of individual batch volume measurements.

(4) Each discharger shall use flow measurement methods that allow the daily volumes for process effluent streams to be determined to an accuracy of within plus or minus fifteen percent.

(5) Each discharger shall determine in cubic metres a daily volume of effluent for each cooling water effluent stream at the discharger's plant for each day on which a sample is collected under this Regulation from the stream.

(6) Each discharger shall use flow measurement methods that allow the daily volumes for cooling water effluent streams to be determined to an accuracy of within plus or minus twenty percent.

(7) Each discharger shall, no later than the day that this section comes into force, determine by calibration or confirm by means of a certified report of a registered professional engineer of the Province of Ontario that each flow measurement method used under subsections (2) and (3) meets the accuracy requirements of subsection (4) and that each flow measurement method used under subsection (5) meets the accuracy requirements of subsection (6).

(8) Where a discharger uses a new flow measurement method or alters an existing flow measurement method, the discharger shall determine by calibration or confirm by means of a certified report of a registered professional engineer of the Province of Ontario that each new or altered flow measurement method meets the accuracy requirements of subsections (4) or (6), as the case may be, within two weeks after the day on which the new or altered method or system is used.

(9) Each discharger shall develop and implement a maintenance schedule and a calibration schedule for each flow measurement system installed at the discharger's plant and shall maintain each flow measurement system according to good operating practices.

(10) Each discharger shall use reasonable efforts to set up each flow measurement system used for the purposes of this section in a way that permits inspection by a provincial officer.

Calculation of Plant Volumes

26.-(1) Each discharger shall calculate, in cubic metres, a daily process effluent plant volume for each day.

(2) For the purposes of subsection (1), a process effluent plant volume for a day is the sum of the daily process effluent volumes determined under section 25 for the day.

(3) Each discharger shall calculate, in cubic metres, a monthly average process effluent plant volume for each month, by taking the arithmetic mean of the daily process effluent plant volumes calculated under subsection (1) for the month.

(4) Each discharger shall calculate, in cubic metres, a daily cooling water effluent plant volume for each day.

(5) For the purposes of subsection (4), a cooling water effluent plant volume for a day is the sum of the daily cooling water volumes determined under section 25 for the day.

(6) Each discharger shall calculate, in cubic metres, a monthly average cooling water effluent plant volume for each month, by taking the arithmetic mean of the daily cooling water effluent plant volumes calculated under subsection (4) for the month.

PART VII - STORM WATER CONTROL STUDY

Storm Water Control Study

27.-(1) Each discharger shall complete a storm water control study in respect of the discharger's plant, in accordance with the requirements of the Ministry of Environment and Energy publication entitled "Protocol for Conducting a Storm Water Control Study", dated August, 1993.

(2) A discharger need not comply with subsection (1) in respect of the discharger's plant if,

(a) the plant meets the exemption criteria set out in the Ministry of Environment and Energy publication

entitled "Protocol for Conducting a Storm Water Control Study," dated August, 1993; and

(b) the discharger notifies the Director in writing, by _____ __, 199_, that the plant meets the exemption criteria referred to in clause (a).

(The date that is one year after the day on which this Regulation is filed will be inserted in clause 27(2)(b).)

(3) Subject to subsection (4), a discharger shall complete the storm water control study in respect of the discharger's plant by _____ __, 199_.

(The date that is two years after the day on which this Regulation is filed will be inserted in subsection 27(3).)

(4) A discharger may postpone completion of the storm water control study in respect of the discharger's plant until _____ __, 199_ if,

(a) in order to meet the requirements of Part IV, the discharger plans to make process changes, install waste water treatment facilities, implement management practices, or make any other changes at the plant that would likely alter the quantity or quality of storm water discharged from the plant; and

(b) the discharger notifies the Director in writing, by _____ __, 199_, of the plans referred to in clause (a).

(The date that is two years after the day on which this Regulation is filed will be inserted in subsection 27(4)(b).)

(5) Each discharger shall ensure that a copy of each study completed under this section is available to Ministry staff at the discharger's plant, on request during the plant's normal office hours.

PART VIII - RECORDS AND REPORTS

Record Keeping

28.-(1) Each discharger shall keep records, in an electronic format acceptable to the Director, of all analytical results obtained under sections 17, 18, 20 and 24, all calculations performed under sections 12 and 13 and all determinations and calculations made or performed under sections 25 and 26.

(2) Each discharger shall keep records of all sampling and analytical procedures used in meeting the requirements of section 7, including, for each sample, the date, the time of pick-up, the sampling procedures used, and any incidents likely to affect the analytical results.

(3) Each discharger shall keep records of the results of all monitoring performed under sections 19 and 21 to 23.

(4) Each discharger shall keep records of all maintenance and calibration procedures performed under section 25.

(5) Each discharger shall keep records of all problems or malfunctions, including those related to sampling, analysis, acute lethality testing, chronic toxicity testing or flow measurement, that result or are likely to result in a failure to comply with a requirement of this Regulation, stating the date, duration and cause of each malfunction, and including a description of any remedial action taken.

(6) Each discharger shall keep records of any incident in which process effluent is discharged from the discharger's plant without flowing past a sampling point established on a process effluent stream in accordance with this Regulation before being discharged, stating the date, duration, cause and nature of each incident.

(7) Each discharger shall keep records of all process changes and redirections of or changes in the character of effluent streams that affect the quality of effluent at any sampling point established under this Regulation at the discharger's plant.

(8) Each discharger shall keep records of the daily production, in tonnes, for the products listed in Schedule 4 for the discharger's plant.

(9) Each discharger shall keep records of the location of each sampling point established at the discharger's plant under Part II.

(10) Each discharger shall make each record required by this section as soon as reasonably possible and shall keep each such record for a period of three years.

(11) Each discharger shall ensure that all records kept under this section are available to Ministry staff at the discharger's plant, on request during the plant's normal office hours.

Reports Available to the Public

29.-(1) On or before June 1 in each year, each discharger shall prepare a report relating to the previous calendar year and including,

(a) a summary of plant loadings calculated under section 12 and 13;

(b) a summary of results of monitoring performed under sections 17, 18 and 20 to 24;

(c) a summary of calculations performed under subsections 26(1) and (4);

(d) a summary of the loadings or other results that exceeded a limit prescribed by section 14 or 15; and

(e) a summary of the incidents in which process effluent was discharged from the discharger's plant without flowing past a sampling point established on a process effluent stream in accordance with this Regulation before being discharged.

(2) Each discharger shall ensure that each report prepared under subsection (1) is available to any person at the discharger's plant, on request during the plant's normal office hours.

(3) Each discharger shall provide the Director, upon request, with a copy of any report that the discharger has prepared under subsection (1).

Reports to the Director - General

30.-(1) Each discharger shall notify the Director in writing of any change of name or ownership of the discharger's plant occurring after _____, 199_, within thirty days after the end of the month in which the change occurs.

(The date that is the day on which this Regulation is filed will be inserted in subsection 30(1))

(2) Each discharger shall notify the Director in writing of any process change or redirection of or change in the character of an effluent stream that affects the quality of effluent at any sampling point established under this Regulation at the discharger's plant, within thirty days of the change or redirection.

(3) A discharger need not comply with subsection (2) where the effect of the change or redirection on effluent quality is of less than one week's duration.

(4) Each discharger shall notify the Director in writing if the discharger's plant has, for more than ninety consecutive days, operated at less than seventy-five percent of the reference production rate specified in Schedule 4 for the discharger's plant, within thirty days of the end of the ninety day period.

Reports to the Director on Compliance with Section 6 and Part IV

31.-(1) Each discharger shall report any incident in which process effluent is discharged from the discharger's plant without flowing past a sampling point established on a process effluent stream in accordance with this Regulation before being discharged.

(2) Each discharger shall report any loading, concentration or other result that exceeds a limit prescribed by section 14 or 15.

(3) A report required under subsection (1) or (2) shall be given orally, as soon as reasonably possible, and in writing, as soon as reasonably possible.

Quarterly Reports to the Director

32.-(1) No later than forty-five days after the end of each quarter, each discharger shall submit a report to the Director containing information relating to the discharger's plant throughout the quarter as required by subsections (3) to (8).

(2) A report under this section shall be submitted both in an electronic format acceptable to the Director and in hard copy generated from the electronic format and signed by the discharger.

(3) A report under this section shall include all information included in a report given under section 31 during the quarter.

(4) Each discharger shall report, for each month in the quarter, the monthly average plant loadings and the highest and lowest daily plant loadings calculated under section 12 and 13 for each limited parameter and each assessment parameter.

(5) Each discharger shall report, for each month in the quarter, the monthly average process effluent plant volume and the highest and lowest daily process effluent plant volumes calculated under section 26.

(6) Each discharger shall report, for each month in the quarter, the monthly average cooling water effluent plant volume and the highest and lowest daily cooling water effluent plant volumes calculated under section 26.

(7) Each discharger shall report the number of days in each month in the quarter on which process effluent was discharged from the discharger's plant.

(8) Each discharger shall report, for each month in the quarter, the highest and lowest pH results obtained under section 20 for each process effluent monitoring stream at the discharger's plant.

Reports to the Director on Chronic Toxicity Testing

33.-(1) Each discharger shall report to the Director the results of all monitoring performed under section 23, together with the date on which each sample was picked up, no later than sixty days after the end of each semi-annual period in which the monitoring was performed.

(2) A report under subsection (1) shall include a plot of percentage reduction in growth or reproduction against the logarithm of test concentration and shall include a calculation of the concentration at which a 25 per cent reduction in growth or reproduction would occur.

PART IX - COMMENCEMENT AND REVOCATION PROVISIONS

Revocation of O.Reg. 359/88

34. Ontario Regulation 359/88 is revoked on _____ __, 199 _.

(The date that is 90 days after the day on which this Regulation is filed will be inserted in section 34.)

Commencement of Parts IV, V and VI

35.-(1) Part IV comes into force on _____ __, 199 _.

(The date that is three years after the day on which this Regulation is filed will be inserted in subsection 35(1).)

(2) Parts V and VI come into force on _____ __, 199 _.

(The date that is 90 days after the day on which this Regulation is filed will be inserted in subsection 35(2).)

Schedule 1:

List of Regulated Plants

Plant Name	Location	Owner as of October 1992
Canada Alloy Casting Ltd.	Kitchener	Canada Alloy Casting Ltd.
Chrysler, Etobicoke Casting Plant	Toronto	Chrysler Canada Ltd.
Ford Motor Company of Canada Ltd. Windsor Casting Plant	Windsor	Ford Motor Company of Canada, Limited
Haley Industries Ltd.	Haley	Haley Industries Ltd.
Kubota Metal Corporation, Fahramet Division	Orillia	Kubota Corporation, Japan
Meridian Richmond Die Casting Ltd.	Cornwall	Meridian Technologies Inc.
Western Foundry Company Limited	Wingham	R.W.L. Investments Ltd. L.F.T. Investments Ltd.

Schedule 2:

Process Effluent Limits and Monitoring Frequency

PLANT: **Ford Motor Company of Canada, Limited**
Windsor Casting Plant
Windsor

ATG	Parameter	Monitoring Frequency	Daily Plant Loading Limit	Monthly Average Plant Loading Limit
			kg/day	kg/day
	Column 1	Column 2	Column 3	Column 4
2	Total Cyanide	W	4.19	2.52
4b	Nitrite + Nitrate	W	84.1	51.5
5a	Dissolved Organic Carbon (DOC)	D	1070	520
8	Total Suspended Solids (TSS)	D	14500	2750
9	Aluminum	W	632	127
	Zinc	W	137	29.7
14	Phenolics (4AAP)	D	34.4	7.35

Explanatory notes:

D = Daily monitoring requirement
W = Weekly monitoring requirement
ATG = Analytical Test Group
kg/day = kilograms per day

Schedule 2:

Process Effluent Limits and Monitoring Frequency

PLANT: **Haley Industries Ltd., Haley**

ATG	Parameter	Monitoring Frequency	Daily Plant Loading Limit kg/day	Monthly Average Plant Loading Limit kg/day
	Column 1	Column 2	Column 3	Column 4
1a	Biochemical Oxygen Demand	W	14.9	6.04
2	Total Cyanide	W	1.68	0.660
4a	Ammonia plus Ammonium	W	22.0	12.1
6	Total Phosphorus	W	1.42	0.519
8	Total Suspended Solids (TSS)	D	29.9	6.04
9	Aluminum	W	2.84	0.604
	Chromium	W	1.09	0.242
	Copper	W	0.896	0.242
	Silver	W	0.481	0.179
	Zinc	W	1.26	0.242
14	Phenolics (4AAP)	D	0.0727	0.0118

Explanatory notes:

D = Daily monitoring requirement
W = Weekly monitoring requirement
ATG = Analytical Test Group
kg/day = kilograms per day

Schedule 3:
Cooling Water Assessment Monitoring Requirements

PLANT:	Canada Alloy Casting Ltd., Kitchener	
ATG	Parameter	Monitoring Frequency
	Column 1	Column 2
5a	Dissolved Organic Carbon (DOC)	W
8	Total Suspended Solids (TSS)	W

Explanatory notes:

W = Weekly monitoring requirement
ATG = Analytical Test Group

Schedule 3:
Cooling Water Assessment Monitoring Requirements

PLANT:	Chrysler, Etobicoke Casting Plant, Toronto	
ATG	Parameter	Monitoring Frequency
	Column 1	Column 2
5a	Dissolved Organic Carbon (DOC)	W
8	Total Suspended Solids (TSS)	W
30	Fluoride	W

Explanatory notes:

W = Weekly monitoring requirement
ATG = Analytical Test Group

Schedule 3:
Cooling Water Assessment Monitoring Requirements

PLANT:	Kubota Metal Corporation, Fahramet Division, Orillia	
ATG	Parameter	Monitoring Frequency
	Column 1	Column 2
5a	Dissolved Organic Carbon (DOC)	W
8	Total Suspended Solids (TSS)	W
14	Phenolics (4AAP)	W

Explanatory notes:

W = Weekly monitoring requirement
ATG = Analytical Test Group

Schedule 3:
Cooling Water Assessment Monitoring Requirements

PLANT:	Meridian Richmond Die Casting Ltd., Cornwall	
ATG	Parameter	Monitoring Frequency
	Column 1	Column 2
5a	Dissolved Organic Carbon (DOC)	W
8	Total Suspended Solids (TSS)	W

Explanatory notes:

W = Weekly monitoring requirement
ATG = Analytical Test Group

Schedule 3:
Cooling Water Assessment Monitoring Requirements

PLANT:	Western Foundry Company Limited, Wingham	
ATG	Parameter	Monitoring Frequency
	Column 1	Column 2
5a	Dissolved Organic Carbon (DOC)	W
8	Total Suspended Solids (TSS)	W
14	Phenolics (4AAP)	W
30	Fluoride	W

Explanatory notes:

W = Weekly monitoring requirement
ATG = Analytical Test Group

Schedule 4:

Reference Production Rate

Plant Name	Products	Reference Production Rate (tonnes/day)
Column 1	Column 2	Column 3
Ford Motor Company of Canada Ltd., Windsor Casting Plant	Automotive parts	1,180
Haley Industries Ltd.	Aerospace castings	4.5